NOT MEASUREMENT SENSITIVE

MIL-STD-187-700B
2 April 1996

SUPERSEDING
MIL-STD-187-700A
27 SEPTEMBER 1994

DEPARTMENT OF DEFENSE
INTERFACE STANDARD

INTEROPERABILITY
AND
PERFORMANCE STANDARDS
FOR THE
DEFENSE INFORMATION SYSTEM

FOREWORD

1. This standard is approved for use by all Departments and Agencies of the Department of Defense (DoD).

2. Interoperability of DoD telecommunications systems, and of DoD with non-DoD telecommunications systems, has been and will continue to be a major consideration in developing and adopting standards for military use.

a. Military standards (MIL-STD) in the 188 series (MIL-STD-188-XXX) address specific telecommunications design parameters that have been proven to work. MIL-STDs are to be used in all new or major upgrades of inter-and intra-DoD systems and equipment, and are to interface with commercial non-DoD systems and equipment to ensure interoperability.

b. MIL-STDs in the 187 series (MIL-STD-187-XXX) address evolving telecommunications design parameters and concepts that are subject to change and that have not been adequately proven through the use of empirical test data. MIL-STD-187-XXX standards should be used as planning standards and guides until parameters are proven and included in approved federal, allied, MIL-STD-188-XXX, or DoD-adopted commercial standards.

c. MIL-STDs in the 2045 series (MIL-STD-2045-XXXXX) address DoD Communications Protocol Standards (DCPS). A DCPS may be either a base standard or a functional profile. MIL-STD-2045 standards will include enhancements to commercial standards or include new protocol standards that are entirely unique to DoD. The 2045 series also allows for a category of interim DoD standards. Interim standards are needed because of the usual disparity between immediate DoD needs and the amount of time required in the commercial world to adopt new standards.

3. MIL-STD-187-XXX standards provide uniform guidance for the design of the evolving and future Defense Information System (DIS) at the information-transfer level. Providing this guidance at the concept engineering stage will help minimize ineffective designs and costly interoperability problems at later stages of implementation, as well as ensure use of appropriate advances in technology. Planning standards are developed considering current and future plans for the DIS, commercial systems (national and international), and North Atlantic Treaty Organization (NATO) and other allied military systems. These standards are usually based on or make reference to American National Standards Institute (ANSI) standards, International Telecommunications Union-Telecommunication Standardization Sector (ITU-T) [formerly the International Telegraph and Telephone Consultative Committee (CCITT)] Recommendations, International Organization for Standardization (ISO) standards, NATO standardization agreements (STANAG), and other MIL-STDs, wherever applicable.

4. This MIL-STD contains the technical standards and design objectives necessary to allow strategic and tactical users to exchange all forms of information digitally, using the DIS. The standards contained herein are common to both tactical and strategic systems, unless otherwise specified. This MIL-STD addresses all interoperability elements specified in the DIS framework, except data-processing standards such as standard programming languages and data elements.

5. The standards in this MIL-STD are based on, or make reference to, corresponding parameters in other MIL-STDs, as well as ANSI standards, ITU-T (CCITT) Recommendations, ISO standards, and NATO STANAGs, wherever applicable. Users of this MIL-STD should be aware that there may be patent rights, copyright claims, or both, by companies or individuals on portions of the MIL-STD. Before incorporating this MIL-STD into systems or equipment, users are advised to contact the appropriate standards organization, such as ANSI, regarding claims or conditions that pertain to the use of an applicable commercial standard. Implementers of this MIL-STD are solely responsible for compensating companies or individuals entitled to any royalties.

6. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to:

Defense Information Systems Agency
Joint Interoperability and Engineering Organization
ATTN: JEBBB
Fort Monmouth, New Jersey 07703-5613

by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter. For immediate concerns, questions can be resolved by phone, (908) 532-7720 or DSN 992-7720; by fax, (908) 389-8333; or by e-mail, liguorir@FTM.DISA.MIL.

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1. SCOPE

1.1 Purpose. The purpose of this military standard (MIL-STD) is to provide a baseline for planning and designing the evolving Defense Information System Network (DISN), defined in 1.7.

1.2 Applicability. This MIL-STD is to be used in planning, designing, and developing new Defense Information System (DIS) communications systems, and in making major changes to existing systems. This MIL-STD does not necessarily apply to leased commercial facilities, but such facilities should be selected to be compatible with its requirements. This MIL-STD applies to digital communications systems only.

1.3 Objectives. This MIL-STD has five objectives:

a. To achieve interoperability between strategic and tactical digital networks for voice, data, facsimile, record traffic, and video services.

b. To provide performance standards for strategic and tactical system users.

c. To adopt specific subsets of commercial standards, where feasible, to achieve cost-effective interoperability, performance, and interfaces.

d. To provide a framework to change existing standards and prepare new standards.

e. To establish a reference source for use by all organizations involved in developing the DISN and procuring DISN-compatible hardware and software.

1.4 System standards and design objectives. When procurement, engineering, or design activities elect to incorporate this planning standard in their acquisition documents, the parameters and requirements specified in this MIL-STD shall be treated as mandatory system standards if the word *shall* is used. Nonmandatory parameters, requirements, and design objectives are indicated by the word *should* (design objectives, rather than standards, are used when there is a lack of measured and verified data or no consensus on the interpretation of the data). *Will* is used to express a declaration of purpose or intent. For a definition of *system standards* and *design objectives*, see Federal Standard (FED-STD)-1037.

1.5 Standards action areas. This MIL-STD addresses the interoperability, performance, and interface standards that should be met by future Department of Defense (DoD) information systems to provide a wide variety of end-to-end digital subscriber services in a single integrated network. These services include voice telephony, data transmission, facsimile, record traffic, and video teleconferencing (VTC). This MIL-STD addresses standardization in eight major areas:

a. Subscriber services

b. Interfaces, including protocols and voice algorithms

c. Circuit switching and packet switching

d. Transmission

e. Signaling

f. Information security

g. Network management and system control

h. End-to-end performance requirements

In accordance with MIL-STD-970, the standards are based on American National Standards Institute (ANSI) standards; International Telecommunications Union-Telecommunication Standardization Sector (ITU-T) Recommendations for the Integrated Services Digital Network (ISDN); the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) reference model; and existing MIL-STD-188 and MIL-STD-2045 series standards. This MIL-STD references other existing standards (military, federal, commercial, and international). The intent is to avoid duplication of existing standards, ensure backward interoperability, and provide for orderly transition to forward-looking standards for new systems.

1.6 DIS framework. The standards provided in this MIL-STD are based on the DIS framework (see section 4, Figure 1) described below:

a. The DIS concept provides for an evolutionary integration of existing and future DoD computer and telephone communications systems. The Services and Agencies adopted the DIS framework as a guide for developing this MIL-STD. The DIS framework provides efficient, end-to-end, integrated service for information sources, sinks, and processors. Integrated service provides for voice, message, data, graphics, and imagery information-transfer across a single network interface.
By definition, the DIS framework includes all components necessary to achieve interoperability between DoD users.

b. The DIS framework consists of three major sections, demarcated by reference points A and B. Users may access the DIS through subscriber network elements, such as source, sink, or processor terminal equipment. These terminal equipment include telephones, facsimile machines, VTC, and other data terminal equipment (DTE). For the information source, sink, or processor elements to be interoperable, all seven layers of the ISO OSI reference model must be interoperable.

c. DTEs exchange information through information-transfer utilities, which are comprised of local-network elements, wide-network elements, and their respective interoperability reference points. The military Services provide fixed-plant, local-network elements to support strategic users and base operations. They also provide tactical local-network elements to support garrison operations and access to wide-network elements, as well as tactical local-network elements to support deployed combat forces. The Defense Information Systems Agency (DISA) provides wide-network elements to interconnect geographically separated local networks. The wide network includes the Defense Information System Network (DISN) and public switched telephone networks (PSTN). Since the local- and wide-network elements and interoperability reference points in the information-transfer utilities represent the telecommunications portion of DIS, their functionality is limited to the lower three layers of the OSI reference model.

d. Advances in computer and telephone communications technology allow multiple services to be provided by a single network, as in ISDN. Wherever applicable, the DIS framework allows the adoption of ANSI standards for ISDN. Within the DIS framework, circuit-switched voice and data services are based on MIL-STDs for tactical systems and ISDN commercial standards for strategic systems.

1.7 <u>Defense Information Infrastructure (DII)/Defense Information System Network (DISN)</u>. The DII is defined as the worldwide aggregation of all mobile and fixed DoD information systems, including sensors, data entry devices, and management and control facilities. The DII allows DoD to collect, produce, store, disseminate, display, and secure information. It consists of communications and all supporting resources, such as network management, control, and value-added services. The DII and DIS are the same, and include the information transport segment (DISN) as well as the information processing segment [such as Corporate Information Management (CIM) megacenters and user terminals] of the information infrastructure.

The DISN includes all telecommunications resources, as described in 4.1. It extends from the wide-area network to the information-transfer and transform functions of the end-user computing and terminal equipment. This equipment includes software and hardware required to interconnect user terminal equipment and software, as well as local-area networks, local-access switches, and radio terminals.

1.8 Waivers for use of specifications and standards. Performance specifications and standards and non-Government standards shall be used instead of detailed Government specifications and standards. In those cases in which a detailed Government specification or standard (such as military specifications and standards, program-unique detailed specifications and standards, and federal specifications and standards) is needed in a solicitation to define an exact design solution, the DoD program office or buying command may use a Government specification or standard, but only if a waiver is granted. The Standards Improvement Executives (SIE) for the military departments and Defense Logistics Agency may exempt a specification or standard from the waiver process for their use in the solicitation, as they deem necessary. DoD components that do not have an SIE may request a similar exemption from the chairman of the Defense Standards Improvement Council. These exemptions must be renewed at least every two years. The following types of documents do not require waivers:

a. Any document required by law, the Federal Acquisition Regulation, or the Defense Federal Acquisition Regulation Supplement.

b. Non-Government standards.

c. Federal Information Processing Standards.

d. Government specifications designated in the DoD Index of Specifications and Standards (DoDISS) as performance specifications.

e. Commercial item descriptions listed in the DoDISS.

f. Guide specifications listed in the DoDISS.

g. Interface standards listed in the DoDISS.

h. Standard Practices listed in the DoDISS.

i. Guides listed in the DoDISS.

j. Handbooks listed in the DoDISS.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, and 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, and 5 of this standard, whether or not they are listed.

2.2 Government documents

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the Department of Defense Index of Specifications and Standards (DoDISS) and supplements thereto, cited in the solicitation.

STANDARDS

FEDERAL

FED-STD-1002	Time and Frequency Reference Information in Telecommunication Systems
FED-STD-1016	Telecommunications: Analog to Digital Conversion of Radio Voice by 4,800 Bit/Second Code Excited Linear Prediction (CELP)
FED-STD-1037	Glossary of Telecommunication Terms
FED-STD-1047	Telecommunications: HF Radio Automatic Message Exchange (Draft)
FED-STD-1048	Telecommunications: HF Radio Automatic Networking to Multimedia (Draft)
FED-STD-1055	Telecommunications: Interoperability Requirements for Meteor Burst Radio Communications Between Conventional Master and Remote Stations
FED-STD-1056	Telecommunications: Interoperability Requirements for the Encryption of Meteor Burst Radio Communications
FED-STD-1057	Telecommunications: Interoperability Requirements for Meteor Burst Radio

	Communications Between Networks by Master Stations

FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATIONS (FIPS PUBS)

FIPS PUB 146	Profile for Open Systems Internetworking Technologies (POSIT)
FIPS PUB 179	Government Network Management Profile (GNMP)
FIPS PUB 182	Integrated Services Digital Network (ISDN)

DEPARTMENT OF DEFENSE

MIL-STD-187-721	Planning and Guidance Standard for Automated Control Applique for HF Radio
MIL-STD-188-105	All-Digital Tactical-to-Strategic Gateway
MIL-STD-188-110	Interoperability and Performance Standards for Data Modems
MIL-STD-188-111*	Interoperability and Performance Standards for Fiber Optic Communications Systems
MIL-STD-188-112	Subsystem Design and Engineering Standards for Common Long Haul/Tactical Cable and Wire Communications
MIL-STD-188-113	Interoperability and Performance Standards for Analog-to-Digital Conversion Techniques
MIL-STD-188-114	Electrical Characteristics of Digital Interface Circuits
MIL-STD-188-115	Interoperability and Performance Standards for Communications Timing and Synchronization Subsystems

* NOTE: This standard is not listed in the DoDISS as an interface standard; thus, it requires a waiver if used in a solicitation.

MIL-STD-188-124*	Grounding, Bonding and Shielding for Common Long Haul/Tactical Communication Systems Including Ground Based Communications-Electronics Facilities and Equipments

MIL-STD-188-136	EHF Medium Data Rate (MDR) Satellite Data Link Standards (SDLS): Uplinks and Downlinks (Draft)
MIL-STD-188-140	Equipment Technical Design Standards for Common Long Haul/Tactical Radio Communications in the Low Frequency Band and Lower Frequency Bands
MIL-STD-188-141	Interoperability and Performance Standards for Medium and High Frequency Radio Equipment
MIL-STD-188-145	Interoperability and Performance Standards for Digital LOS Microwave Radio Equipment
MIL-STD-188-148	Interoperability Standard for AJ Communications in the High Frequency (2-30 MHz) Band (U), SECRET
MIL-STD-188-161	Interoperability and Performance Standards for Digital Facsimile Equipment
MIL-STD-188-164	Interoperability and Performance Standards for C-Band, X-Band, and Ku-Band SHF Satellite Communications Earth Terminals
MIL-STD-188-165	Interoperability and Performance Standards for SHF Satellite Communications PSK Modems (FDMA Operation)
MIL-STD-188-166	Interoperability and Performance Standards for SHF SATCOM Link Control (Draft)

* NOTE: This standard is not listed in the DoDISS as an interface standard; thus, it requires a waiver if used in a solicitation.

MIL-STD-188-167	Interoperability and Performance Standards for SHF SATCOM Demand Assignment (Draft)
MIL-STD-188-168	Interoperability and Performance Standards for SHF SATCOM Multiplexer (Draft)
MIL-STD-188-169	Interoperability and Performance Standards for C-Band and Ku-Band Satellite Communications Nonprocessing Transponders (Draft)
MIL-STD-188-171	Interoperability Standards for Information and Record Traffic Exchange, Mode I

MIL-STD-188-172	Interoperability Standards for Information and Record Traffic Exchange, Mode II
MIL-STD-188-173	Interoperability Standards for Information and Record Traffic Exchange, Mode V
MIL-STD-188-174	Interoperability Standards for Information and Record Traffic Exchange, Mode VI
MIL-STD-188-181	Interoperability Standard for Dedicated 5-kHz and 25-kHz UHF Satellite Communications Channels
MIL-STD-188-182	Interoperability Standard for 5-kHz UHF DAMA Terminal Waveform
MIL-STD-188-183	Interoperability Standard for 25-kHz UHF TDMA/DAMA Terminal Waveform
MIL-STD-188-184	Interoperability and Performance Standard for the Data Control Waveform
MIL-STD-188-185	Interface Interoperability Standard for UHF MILSATCOM DAMA Control System (Draft)
MIL-STD-188-190*	Methods for Communications Systems Measurements

* NOTE: This standard is not listed in the DoDISS as an interface standard; thus, it requires a waiver if used in a solicitation.

MIL-STD-188-196	NITFS, Bi-Level Image Compression
MIL-STD-188-197	NITFS, Adaptive Recursive Interpolated Differential Pulse Code Modulation (ARIDPCM)
MIL-STD-188-198	NITFS, Joint Photographic Experts Group (JPEG) Image Compression
MIL-STD-188-199	NITFS, Vector Quantization Decompression
MIL-STD-188-200	System Design and Engineering Standards for Tactical Communications
MIL-STD-188-202	Interoperability and Performance Standards for Tactical Digital Transmission Groups (Coaxial Cable)
MIL-STD-188-203-1	Interoperability and Performance Standards for Tactical Digital Information Link (TADIL) A

MIL-STD-188-203-3	Subsystem Design and Engineering Standards for Tactical Digital Information Link (TADIL) C
MIL-STD-188-212	Subsystem Design and Engineering Standards for Tactical Digital Information Link (TADIL) B
MIL-STD-188-216	Interoperability Standards for Data Adapter Control Mode
MIL-STD-188-220	Interoperability Standard for Digital Message Transfer Device Subsystems
MIL-STD-188-242	Interoperability and Performance Standards for Tactical Single Channel Very High Frequency (VHF) Radio Equipment
MIL-STD-188-243	Interoperability and Performance Standards for Tactical Single Channel Ultra High Frequency (UHF) Radio Communications
MIL-STD-188-256	Interoperability and Performance Standards for Digital Signaling and Supervision of Tactical Communications Systems
MIL-STD-188-260	Design and Engineering Standards for Tactical Terminal Subsystems
MIL-STD-188-311	Technical Design Standards for Frequency-Division Multiplexers
MIL-STD-210	Climatic Information to Determine Design and Test Requirements for Military Systems and Equipment
MIL-STD-449*	Radio Frequency Spectrum Characteristics, Measurement of
MIL-STD-461*	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-462*	Electromagnetic Interference Characteristics, Measurement of
MIL-STD-781*	Reliability Testing for Engineering Development, Qualification, and Production

MIL-STD-785*	Reliability Program for Systems and Equipment Development and Production
MIL-STD-810*	Environmental Test Methods and Engineering Guidelines
MIL-STD-1472*	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-1582	EHF Low Data Rate (LDR) Satellite Data Link Standards (SDLS) Uplinks and Downlinks (SECRET)
MIL-STD-2045-13500	Information Technology - DoD Standardized Profiles - Internet Relay Profiles
MIL-STD-2045-13500-1	Subnetwork Independent Requirements for Relaying IP

* NOTE: This standard is not listed in the DoDISS as an interface standard; thus, it requires a waiver if used in a solicitation.

MIL-STD-2045-13500-2	Subnetwork Dependent Requirements for the Point-to-Point Protocol (PPP)
MIL-STD-2045-13501	Information Technology - DoD Standardized Profiles - Internet Routing Between Autonomous Systems
MIL-STD-2045-14500 Series	Transport Profiles
MIL-STD-2045-14500-1	Information Technology - DoD Standardized Profiles TA21(D) Transport Profile Part 1: Reliable End System (ES) Transport
MIL-STD-2045-14500-2	Information Technology - DoD Standardized Profiles TA21(D) Transport Profile Part - COTS Over CLNS Part 2: Balanced Point-to-Point Digital Data Circuit
MIL-STD-2045-14500-3	Information Technology - DoD Standardized Profiles TA21(D) Transport Profile - COTS Over CLNS Part 3: Subnetwork for an Unbalanced Link

MIL-STD-2045-14500-4	Information Technology - DoD Standardized Profiles TA21(D) Transport Profile Part 4: Local Area Networks (LANs), Using Token Bus
MIL-STD-2045-14500-5	Information Technology - DoD Standardized Profiles TA21(D) Transport Profile Part 5: Local Area Networks (LANs), Using Token Ring
MIL-STD-2045-14500-6	Information Technology - DoD Standardized Profiles TA21(D) Transport Profile Part 6: Integrated Services Digital Network (ISDN)
MIL-STD-2045-14502 Series	Internet Transport Profiles

MIL-STD-2045-14502-1	Information Technology - DoD Standardized Profiles - Internet Transport Profile for DoD Communications - Part 1: Transport and Internet Services
MIL-STD-2045-14502-2	Information Technology - DoD Standardized Profiles - Internet Transport Profile for DoD Communications - Part 2: Point-to-Point Links
MIL-STD-2045-14502-3	Information Technology - DoD Standardized Profile - Internet Transport Profile - Part 3: Wide Area Network Access
MIL-STD-2045-14502-4	Information Technology - DoD Standardized Profile - Internet Transport Profile - Part 4: IEEE 802 Local Area Network (LAN) Media Independent Requirements
MIL-STD-2045-14502-5	Information Technology - DoD Standardized Transport Profile - Internet Transport Profile for DoD Communications - Part 5: IEEE 802 Local Area Network (LAN) Media Dependent Requirements
MIL-STD-2045-14502-6	Information Technology - DoD Standardized Profile - Internet Transport Profile for DoD Communications - Part 6: Combat Net Radio (CNR)
MIL-STD-2045-14503	Information Technology - DoD Standardized Profiles - Internet Transport Service Supporting OSI Applications
MIL-STD-2045-17503 Series	Internet Message Transport Profile
MIL-STD-2045-17503-1	Information Technology - DoD Standardized Profiles - Internet Message Transfer Profile for DoD Communications - Part 1: Simple Mail Transfer Protocol (SMTP)

MIL-STD-2045-17503-2	Information Technology - DoD Standardized Profiles - Internet Message Transfer Profile for DoD Communications - Part 2: Format of Text Messages
MIL-STD-2045-17504	Information Technology - DoD Standardized Profiles - Internet File Transfer Profile for DoD Communications
MIL-STD-2045-17505	Information Technology - DoD Standardized Profiles - Internet Domain Name Service (DNS) Profile for DoD Communications
MIL-STD-2045-17506	Information Technology - DoD Standardized Profile - Internet Remote Login Profile for DoD Communications
MIL-STD-2045-17507 Series	Internet Network Management Profiles
MIL-STD-2045-17507-1	Information Technology - DoD Standardized Profiles - Internet Network Management Profile for DoD Communications - Part 1: Simple Network Management Protocol (SNMP)
MIL-STD-2045-17507-2	Information Technology - DoD Standardized Profiles - Internet Network Management Profile for DoD Communications - Part 2: Management Information Base (MIB)
MIL-STD-2045-17507-3	Information Technology - DoD Standardized Profiles - Internet Network Management Profile for DoD Communications - Part 3: Structure and Identification of Management Information
MIL-STD-2045-17508	Information Transfer DoD Profiles AFT1n(D) - File Transfer, Access and Management (FTAM)

MIL-STD-2045-17508-1	Information Technology - DoD Standardized Profiles AFT1n(D) - File Transfer, Access and Management - Part 1: Specification of ACSE, Presentation and Session Protocols for use by FTAM
MIL-STD-2045-17508-2	Information Technology - DoD Standardized Profiles AFT1n(D) - File Transfer, Access and Management - Part 2: Definition of Document Types, Constraint Sets and Syntaxes
MIL-STD-2045-17508-3	Information Technology - DoD Standardized Profiles AFT1n(D) - File Transfer, Access and Management - Part 3: AFT11 - Simple File Transfer Service (unstructured)
MIL-STD-2045-17508-4	Information Technology - DoD Standardized Profiles AFT1n(D) - File Transfer, Access and Management - Part 4: Positional File Transfer Service for Flat Files
MIL-STD-2045-17508-5	Information Technology - DoD Standardized Profiles AFT1n(D) - File Transfer, Access and Management - Part 5: Positional File Access Service for Flat Files
MIL-STD-2045-17508-6	Information Technology - DoD Standardized Profiles AFT1n - File Transfer, Access and Management - Part 6: AFT3 - File Management Service
MIL-STD-2045-18500 Series	Message Handling Systems
MIL-STD-2045-18500-1	Information Technology DoD Standardized Profiles AMHXn(D) - Message Handling Systems - Message Security Protocol - Part 1: MSP Service Support

MIL-STD-2045-18500-2	Information Technology DoD Standardized Profiles AMHXn(D) - Message Handling Systems - Message Security Protocol - Part 2: AMHX1(D) - MSP Content Protocol
MIL-STD-2045-18500-3	Information Technology DoD Standardized Profiles AMHXn(D) - Message Handling Systems - Message Security Protocol - Part 3: AMHX2(D) - MSP Requirements for Message Transfer (P1)
MIL-STD-2045-18500-4	Information Technology DoD Standardized Profiles AMHXn(D) - Message Handling Systems - Message Security Protocol - Part 4: AMHX3(D) - MSP Requirements for MTS Access (P3)
MIL-STD-2045-18500-5	Information Technology DoD Standardized Profiles AMHXn(D) - Message Handling Systems - Message Security Protocol - Part 5: AMHX4(D) - MSP Requirements for MS Access (P7)
MIL-STD-2045-38000	DoD Network Management for DoD Communications
MIL-STD-2045-44500	Tactical Communications Protocol 2 (TAC02) for the NITFS
MIL-STD-2045-47001	Connectionless Data Transfer, Application Layer Standard
MIL-STD-2045-48501	Common Security Label
MIL-STD-2301	Computer Graphics Metafile Implementation for the National Imagery Transmission Format Standard
MIL-STD-2500	National Imagery Transmission Format Standard
MIL-STD-46855	Human Engineering Requirements for Military Systems, Equipment and Facilities

HANDBOOKS

MIL-HDBK-232	RED/BLACK Engineering-Installation Guidelines
MIL-HDBK-235	Electromagnetic (Radiated) Environment Considerations for Design and Procurement of Electrical and Electronic Equipment, Subsystems and Systems
MIL-HDBK-237	Electromagnetic Compatibility Management Guide for Platforms, Systems and Equipments
MIL-HDBK-241	Design Guide for Electromagnetic Interference (EMI) Reduction in Power Supplies
MIL-HDBK-253	Guidance for the Design and Test of Systems Protected Against the Effects of Electromagnetic Energy
MIL-HDBK-419	Vol I, Grounding, Bonding and Shielding for Electronic Equipments and Facilities Basic Theory; and Vol II, Grounding Bonding, and Shielding for Electronic Equipments and Facilities Applications
MIL-HDBK-470*	Maintainability Program for Systems and Equipment
MIL-HDBK-471*	Maintainability Verification/ Demonstration/Evaluation
MIL-HDBK-829A	Guidelines for Developing Data Communications Protocol Standards
MIL-HDBK-1300	National Imagery Transmission Format Standard (NITFS)
MIL-HDBK-1350-1	Validation of Data Communications Protocol Standards for Military Applications
MIL-HDBK-1350-2	Data Communications Protocol Conformance and Interoperability Testing and Registration, Volume 2, September 1993 (Draft)

* NOTE: This standard is not listed in the DoDISS as an interface standard; thus, it requires a waiver if used in a solicitation.

MIL-HDBK-1351	Network Management for DoD Communications

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

(Copies of the Federal Information Processing Standards (FIPS) are available to Department of Defense activities from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. Others must request copies from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161-2171.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

CJCSM 6231	Manual for Employing Joint Tactical Communications
DCAC 370-175-13	Defense Switched Network (DSN) System Interface Criteria
DISN Architecture	Defense Information System Network (DISN) Architecture, DISN-AR-1000, 12 May 1993 (Draft)
DoD 5200.28-STD	Department of Defense Trusted Computer System Evaluation Criterion
TAFIM	Technical Architecture Framework for Information Management (TAFIM), Volume 7, Adopted Information Technology Standards (AITS), Version 2.0, 12 November 1994
JIEO Specification 9001	Joint Technical Interface Specification for VHF SINCGARS Waveform
JIEO Specification 9109	Technical Interface Specification: Joint Interoperability via Fiber Optic Cable
PG/6 TCP 2000	Tri-Service Group on Communications and Electronics, Project Group 6 -- Post-2000

(To obtain other DoD publications not found in the DoDISS, contact the Defense Information Systems Agency, Center for Standards, ATTN: JEBBB, Fort Monmouth, NJ 07703-5613.)

NACSEM 5201	TEMPEST Guidelines for Equipment/ System Design (U)

NSTISSAM TEMPEST/ 1-91	Compromising Emanations Laboratory Test Requirements, Electromagnetics (Classified document)

(Requests for NACSEM 5201 and NSTISSAM TEMPEST/1-91 should be submitted to the National TEMPEST Information Center, Attention: C941, National Security Agency, Fort George Meade, MD 20899.)

2.2.3 Standardization Agreements (STANAG) and Allied Communication Publications (ACP). Currently all these STANAGs are not listed in the DoDISS but will be incorporated as soon as possible.

STANAGs

STANAG 4175	Technical Characteristics of the Multi-Functional Information Distribution System (MIDS)
STANAG 4206	The NATO Multi-Channel Tactical Digital Gateway System Standards
STANAG 4207	The NATO Multi-Channel Tactical Digital Gateway Multiplex Group Framing Standards
STANAG 4208	The NATO Multi-Channel Tactical Digital Gateway Signalling Standards
STANAG 4209	The NATO Multi-Channel Tactical Digital Gateway Standards for Analogue-to-Digital Conversion of Speech Signals
STANAG 4210	The NATO Multi-Channel Tactical Digital Gateway Cable Link Standards
STANAG 4211	The NATO Multi-Channel Tactical Digital Gateway System Control Standards
STANAG 4212	The NATO Multi-Channel Tactical Digital Gateway Radio Relay Link Standards
STANAG 4213	The NATO Multi-Channel Tactical Digital Gateway Data Transmission Standards
STANAG 4214	International Routing and Directory for Tactical Communications Systems
STANAG 4249	The NATO Multi-Channel Tactical Digital Gateway -- Data Transmission Standards (Packet Switching Service)

STANAG 4251	NATO Reference Model for Open Systems Interconnection -- Layer 1 (Physical Layer) Service Definition
STANAG 4252	NATO Reference Model for Open Systems Interconnection -- Layer 2 (Data Link Layer) Service Definition
STANAG 4253	NATO Reference Model for Open Systems Interconnection -- Layer 3 (Network Layer) Service Definition
STANAG 4255	NATO Reference Model for Open Systems Interconnection -- Layer 5 (Session Layer) Service Definition (Draft)
STANAG 4256	NATO Reference Model for Open Systems Interconnection -- Layer 6 (Presentation Layer) Service Definition (Draft)
STANAG 4259	NATO Reference Model for Open Systems Interconnection Encoding Rules for ASN.1
STANAG 4261	NATO Reference Model for Open Systems Interconnection -- Layer 1 (Physical Layer) Protocol Specification
STANAG 4262	NATO Reference Model for Open Systems Interconnection -- Layer 2 (Data Link Layer) Protocol Specification; Annex D, Data Link Access Procedure Balanced (LAPB)
STANAG 4263	NATO Reference Model for Open Systems Interconnection -- Layer 3 (Network Layer) Protocol Specification, Annex D, X.75 Packet Level Protocol (STE-STE)
STANAG 4265	NATO Reference Model for Open Systems Interconnection -- Layer 5 (Session Layer) Protocol Specification (Draft)
STANAG 4266	NATO Reference Model for Open Systems Interconnection -- Layer 6 (Presentation Layer) Protocol Specification (Draft)
STANAG 4290	The NATO Multi-Channel Tactical Digital Gateway Cable Link (Optical) Standards (Drafts)

STANAG 4372	Second-generation Anti-jam Tactical UHF Radio for NATO (SATURN)
STANAG 5000	Interoperability of Tactical Digital Facsimile Equipment
STANAG 5516	Tactical Data Exchange Link-16

(Copies of STANAGs, required by contractors in connection with specific acquisition functions, should be obtained from the contracting activity or as directed by the contracting officer.)

ACPs

ACP 123 U.S. Supplement No. 1	Common Messaging Strategy and Procedures

(Requests for Allied Communication Publications should be submitted to the DISA Center for Standards, ATTN: JEBBB, Fort Monmouth, NJ 07703-5613.)

2.2.4 NIST publications. (NIST publications require a waiver when used in a solicitation.)

NIST IR90-4250	Network Transport and Message Security Protocols
NIST Special Publication 500-183	National Institute of Standards and Technology (NIST) Special Publication 500-183, Stable Implementation Agreements for Open Systems Interconnection Protocols, Version 4, Edition 1

(NIST documents can be obtained from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161-2171 or by calling 1-800-553-6847.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation. (Non-Government standards do not require a waiver when used in a solicitation.)

2.3.1 ITU-T (formerly known as CCITT) Recommendations. The ITU-T is part of the United Nations, a treaty organization. The United States government participates in it through the Department of State, and although industry representatives may work on its committees, approval of standards (called Recommendations) is by governments.

ITU-T D.280	Charging, billing, accounting, and reimbursement for UPT
ITU-T E.163	Numbering Plan for the International Telephone Service
ITU-T E.164	Numbering Plan for the ISDN Era
ITU-T E.168	UPT numbering
ITU-T E.174	Routing principle and guidance for UPT
ITU-T E.751	Reference connections for engineering of land mobile networks (Draft)
ITU-T E.755	Reference connections for UPT
ITU-T E.771	Network grade-of-service parameters and target values for circuit-switched public land mobile services (Draft)
ITU-T E.775	UPT grade-of-service concept
ITU-T E.776	Grade-of-service parameters for networks supporting UPT
ITU-T E.780	Traffic engineering methods for land mobile systems (Draft)

ITU-T E.785	Traffic engineering methods for networks supporting UPT
ITU-T F.69	Plan for Telex Destination Codes
ITU-T F.115	Service objectives and principles for FPLMTS
ITU-T F.724	Videotelephony services for FPLMTS (Draft)
ITU-T F.850	UPT service principle
ITU-T F.851	UPT service set 1
ITU-T F.852	UPT service set 2
ITU-T F.853	UPT supplementary service
ITU-T F.sfea	Service features in FPLMTS (Draft)
ITU-T FPLMTS.TMLG	Vocabulary of terms for FPLMTS (Draft)
ITU-T FPLMTS.FMGM	Framework of FPLMTS management (Draft)
ITU-T FPLMTS.RSEL	Procedure for evaluation of radio transmission technologies for FPLMTS (Draft)
ITU-T FPLMTS.SFMK	Framework for the satellite component of FPLMTS (Draft)
ITU-T FPLMTS.SECMOP	Security mechanisms and operating procedures for FPLMTS
ITU-T G.703	Physical/Electrical Characteristics of Hierarchical Digital Interfaces
ITU-T G.704	Synchronous Frame Structures Used at Primary and Secondary Hierarchical Levels
ITU-T G.707	Synchronous Digital Hierarchy Bit Rates
ITU-T G.708	Network Node Interface for the Synchronous Digital Hierarchy
ITU-T G.709	Synchronous Multiplexing Structure

ITU-T G.711	Pulse Code Modulation (PCM) of voice frequencies
ITU-T G.721	32 kbps Adaptive Pulse Code Modulation
ITU-T G.728	Coding of speech at 16 kbps using low-delay code-excited linear prediction (CELP)
ITU-T G.811	Timing Requirements at the Outputs of Primary Reference Clocks Suitable for Plesiochronous Operation of International Digital Links
ITU-T H.26P/M	Extension of H.263 for mobile application (Draft)
ITU-T I.11x	Vocabulary of terms for mobile networks (Draft)
ITU-T I.37w	Network architecture and capabilities for FPLMTS (Draft)
ITU-T I.5xw	Network interworking between FPLMTS and other types of networks (Draft)
ITU-T I.137	UPT network capabilities
ITU-T I.144	Vocabulary-UPT
ITU-T I.252	Call Offering Supplementary Services
ITU-T I.254	Multiparty Supplementary Services
ITU-T I.321	Broadband Integrated Services Digital Network (B-ISDN) Protocol Reference Model and Its Application
ITU-T I.361	Physical Layer Specification
ITU-T I.363	B-ISDN ATM Adaptation Layer (AAL) Specification
ITU-T I.432	B-ISDN User-Network Interface Physical Layer Specification
ITU-T I.460	Multiplexing, Rate Adaptation and Support of Existing Interfaces

ITU-T M.687-1	Future Public Land Mobile Telecommunication Systems (FPLMTS)
ITU-T M.816	Framework for services supported on FPLMTS
ITU-T M.817	FPLMTS network architectures
ITU-T M.818-1	Satellite operation within FPLMTS
ITU-T M.819-1	FPLMTS for developing countries
ITU-T M.1034	Requirements for the radio interface(s) for FPLMTS
ITU-T M.1035	Framework for the radio interface(s) and radio subsystem functionality for FPLMTS
ITU-T M.1036	Spectrum considerations for implementation of FPLMTS in the bands 1885-2025 MHz and 2110-2200 MHz
ITU-T M.1078	Security principles for FPLMTS
ITU-T M.1079	Speech and voiceband data performance requirements for FPLMTS
ITU-T M.32xx	TMN management service for FPLMTS
ITU-T Q.76	Service procedures for UPT
ITU-T Q.704	Signalling Network Functions and Messages
ITU-T Q.774	Transaction Capabilities Procedure
ITU-T Q.920	ISDN User-Network Interface Data Link Layer -- General Aspects
ITU-T Q.921	ISDN User-Network Interface -- Data Link Layer Specification
ITU-T Q.922	ISDN-Data Link Layer Specification for Frame Mode Bearer Service
ITU-T Q.931	ISDN User-Network Interface Layer 3 Specification for Basic Call Control

ITU-T Q.2130	Service-Specific Coordination Function (SSCF) for Signaling at the UNI
ITU-T Q.2140	Service-Specific Coordination Function (SSCF) for Signaling at the NNI
ITU-T Q.2761 to Q.2764	BISDN NNI Network Signaling Requirements
ITU-T Q.2931	BISDN UNI Layer 3 Access Call Control Requirements
ITU-T Q.2971	Point-to-Multipoint Call Connection Control (Draft)
ITU-T Q.FIF	FPLMTS information flows (Draft)
ITU-T Q.FNA	FPLMTS network architecture (Draft)
ITU-T Q.UPT	Stage 3 for support of UPT service set 1 on IN CS1
ITU-T V.35	Data Transmission at 48 Kilobits Per Second Using 60-108 kHz Group Band Circuits
ITU-T V.110	Support of Data Terminal Equipments (DTEs) with V-Series Type Interfaces by an Integrated Services Digital Network (ISDN)
ITU-T X.25	Interface Between Data Terminal Equipment (DTE) and Data Circuit-Terminating Equipment (DCE) for Terminals Operating in the Packet Mode and Connected to Public Data Networks by Dedicated Circuit
ITU-T X.31	Support of Packet Mode Terminal Equipment by an ISDN
ITU-T X.75	Packet-Switched Signalling System Between Public Networks Providing Data Transmission Services
ITU-T X.121	International Numbering Plan for Public Data Networks

ITU-T X.217	Association control Service Definition for Open Systems Interconnection for CCITT Applications
ITU-T X.219	Remote Operations: Model, Notation and Service Definition
ITU-T X.224	Transport Protocol Specification for Open Systems Interconnection for ITU-T Applications
ITU-T X.290	OSI Conformance Testing Methodology and Framework for Protocol Recommendations for ITU-T Applications
ITU-T X.400	Message Handling System and Service Overview
ITU-T X.435	Electronic Data Interchange (EDI) (Draft)
ITU-T X.500	The Directory -- Overview of Concepts, Models and Services

(Copies of International Telegraph and Telephone Consultative Committee (CCITT) standards may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.) [Note: The CCITT has changed its name to the International Telecommunications Union - Telecommunication Standardization Sector (ITU-T).]

2.3.2 American National Standards Institute (ANSI) standards

ANSI T1.101	Synchronization Interface Standards for Digital Service
ANSI T1.105	Digital Hierarchy -- Optical Interface Rates and Formats Specifications
ANSI T1.105.01	Synchronous Optical Network (SONET) -- Automatic Protection Switching
ANSI T1.105.03	Synchronous Optical Network (SONET) -- Jitter at Network Interfaces
ANSI T1.105.09	Synchronous Optical Network (SONET) -- Network Element Timing and Synchronization (Draft)
ANSI T1.106	Digital Hierarchy -- Optical Interface Specifications (Single Mode)

ANSI T1.107	Digital Hierarchy Format Specifications
ANSI T1.111	Signalling System Number 7 (SS7) -- Message Transfer Part (MTP)
ANSI T1.112	Signalling System Number 7 (SS7) -- Signalling Connection Control Part (SCCP)
ANSI T1.113	Signalling System Number 7 (SS7) -- Integrated Services Digital Network (ISDN) User Part
ANSI T1.114	Signalling System Number 7 (SS7) -- Transaction Capability Application Part (TCAP)
ANSI T1.408	ISDN Primary Rate -- Customer Installation Metallic Interfaces, Layer 1 Specification
ANSI T1.601	Integrated Services Digital Network (ISDN) -- Basic Access Interface for Use on Metallic Loops for Application on the Network Side of the NT (Layer 1 Specification)
ANSI T1.602	Integrated Services Digital Network (ISDN) -- Data-Link Layer Signalling Specification for Application at the User-Network Interface
ANSI T1.605	Integrated Services Digital Network (ISDN) -- Basic Access Interface for S and T Reference Points (Layer 1 Specification)
ANSI T1.606	Integrated Services Digital Network (ISDN) -- Architectural Framework and Service Description for Frame-Relaying Bearer Service
ANSI T1.607	Digital Subscriber Signalling System No. 1 -- Layer 3 Signalling Specification for Circuit Switched Bearer Service
ANSI T1.608	Digital Subscriber Signalling System No. 1 (DSS1) -- Signalling Specification for X.25 Packet Switched Bearer Service

ANSI T1.609	Interworking Between the ISDN User -- Network Interface Protocol and the Signalling System Number 7 ISDN User Part
ANSI T1.610	Digital Subscriber Signalling System No. 1 (DSS1) -- Generic Procedures for the Control of ISDN Supplementary Services
ANSI T1.613	Call Waiting Supplementary Service
ANSI T1.616	Call Holding Supplementary Service
ANSI T1.617	Integrated Services Digital Network (ISDN) -- Digital Subscriber Signaling System No. 1 (DSS1) -- Signaling Specification for Frame Relay Bearer Service
ANSI T1.618	Integrated Services Digital Network (ISDN) -- Core Aspects of Frame Protocol for Use with Frame Relay Bearer Service
ANSI T1.619	Integrated Services Digital Network (ISDN) -- Multi-Level Precedence and Preemption (MLPP) Service Capability
ANSI T1.621	Integrated Services Digital Network (ISDN) -- User-to-User Supplementary Service
ANSI T1.622	Integrated Services Digital Network (ISDN) -- Message Waiting Indicator Control and Notification Supplementary Service and Associate Switching and Signaling Specification
ANSI T1.625	Integrated Services Digital Network (ISDN) -- Calling Line Presentation and Restriction Supplementary Services
ANSI T1.627	BISDN - ATM Layer Functionality and Specification
ANSI T1.629	BISDN -- ATM Adaptation Layer 3/4 Common Part Functions and Specifications
ANSI T1.630	BISDN -- ATM Adaption Layer for Constant Bit Rate Services Functionality and Specification

ANSI T1.632-93	ISDN Supplementary Service Normal Call Transfer
ANSI T1.633-93	Frame Relaying Bearer Service Interworking (I.555)
ANSI T1.634-93	Frame Relaying Service-Specific Convergence Sublayer (FR-SSCS) (I.365.1)
ANSI T1.635-94	B-ISDN - AAL-5 Common Part Functions and Spec (I.363, Section 6)
ANSI T1.637-94	B-ISDN Service-Specific Connection-Oriented Protocol (SSCOP) Spec
ANSI T1.642-94	Call Deflection Supplementary Services
ANSI T1S1.2/91-408	Hotline Service Integrated Text
ANSI T1S1.1/92-188	Proposed Integrated Text for Line Hunting Service with Issue Section
ANSI T1S1.1/92-253	Call Completion to Busy Subscriber, Stage 1/2
ANSI T1S1.2/92-323	Call Completion to Busy Subscriber, DSS1, Stage 3 Description
ANSI T1S1.2/94-311	Preset Conference Calling Service, DSS1, Stage 3 Description
ANSI T1S1/94-553	ISDN Explicit Call Transfer
ANSI T1S1/LB95-05	ISDN Call Park Supplementary Service
ANSI X3.4 1986	Code for Information Interchange
ANSI X3.16 1976	Character Structure and Character Parity Sense for Serial-by-Bit Data Communication in ASCII
ANSI X3.25 1968	Character Structure and Character Parity Sense for Parallel-by-Bit Data Communication in ASCII
ANSI X3.229	Fiber Distributed Data Interface (FDDI) Station Management

(Copies of American National Standards Institute (ANSI) standards may be obtained from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036. Draft copies of ANSI standards can be obtained from the Joint Interoperability and Engineering Organization (JIEO), ATTN: JEBBB, Fort Monmouth, NJ 07703-5613.)

2.3.3 International Standards Organization (ISO)/International Electrotechnical Commission(IEC) documents

TR 10000	Information Technology -- Framework and Taxonomy of International Standardized Profiles -- Part 1: Framework, Part 2: Taxonomy of Profiles, and Part 3: Principles and Taxonomy for Open Systems Environment Profiles (Draft)
ISO 3166	Codes for the Representation of Names of Countries
ISO 3309	Information Processing Systems -- Data Communication -- High-Level Data Link Control Procedures -- Frame Structure
ISO 4335	Information Processing Systems -- Data Communication -- High-Level Data Link Control Elements of Procedures
ISO 6523	Data Interchange -- Structure for the Identification of Organizations
ISO 7498	Information Processing Systems -- Open Systems Interconnection -- Basic Reference Model -- X-ref: ITU-T X.200
ISO 7776	Information Processing Systems - Data Communication - High-level Data Link Control Procedures - Description of the X.25 LAPB-Compatible DTE Data Link Procedures
ISO 7809	Information Processing Systems -- Data Communication -- High-Level Data Link Control Procedures -- Consolidation of Classes of Procedures
ISO 8073	Information Processing Systems -- Open Systems Interconnection -- Connection Oriented Transport Protocol Specification -- X-ref: ITU-T X.224

ISO 8208	Information Processing Systems -- Data Communications -- X.25 Packet Level Protocol for Data Terminal Equipment -- X-ref: ITU-T X.25
ISO 8326	Information Processing Systems -- Open Systems Interconnection -- Basic Connection-Oriented Session Service Definition -- See: ITU-T X.215
ISO 8327	Information Processing Systems -- Open Systems Interconnection -- Basic Connection-Oriented Session Protocol Specification -- See: ITU-T X.225
ISO 8348	Information Processing Systems -- Data Communications -- Network Service Definition -- X-ref: ITU-T X.213
ISO 8471	Data Communication -- High-Level Data Link Control Balanced Classes of Procedures -- Data-Link Layer Address Resolution/Negotiation in Switched Environments
ISO 8473	Information Processing Systems -- Data Communications -- Protocol for Providing the Connectionless-Mode Network Service
ISO 8571-1	Information Processing Systems -- Open Systems Interconnection -- File Transfer, Access and Management -- Part 1: General Introduction
ISO 8571-3	Information Processing Systems -- Open Systems Interconnection -- File Transfer, Access and Management -- Part 3: File Service Definition

ISO 8571-4	Information Processing Systems -- Open Systems Interconnection -- File Transfer, Access and Management -- Part 4: File Protocol Specification
ISO 8613-1	Information Processing -- Text and Office Systems -- Office Document Architecture (ODA) and Interchange Format -- Part 1: Introduction and General Principles -- X-ref: ITU-T T.411
ISO 8613-2	Information Processing -- Text and Office Systems -- Office Document Architecture (ODA) and Interchange Format -- Part 2: Document Structures -- X-ref: ITU-T T.412
ISO 8613-4	Information Processing -- Text and Office Systems -- Office Document Architecture (ODA) and Interchange Format -- Part 4: Document Profile -- X-ref: ITU-T T.414
ISO 8613-5	Information Processing -- Text and Office Systems -- Office Document Architecture (ODA) and Interchange Format -- Part 5: Office Document Interchange Format (ODIF) -- X-ref: ITU-T T.415
ISO 8613-6	Information Processing -- Text and Office Systems -- Office Document Architecture (ODA) and Interchange Format -- Part 6: Character Content Architectures -- X-ref: ITU-T T.416
ISO 8613-7	Information Processing -- Text and Office Systems -- Office Document Architecture (ODA) and Interchange Format -- Part 7: Raster Graphics Content Architectures -- X-ref: ITU-T T.417
ISO 8613-8	Information Processing -- Text and Office Systems -- Office Document Architecture (ODA) and Interchange Format -- Part 8: Geometric Graphics Content Architectures -- X-ref: ITU-T T.418

ISO 8632	Computer Graphics Metafile
ISO 8649	Information Processing Systems -- Open Systems Interconnection -- Service Definition for the Association Control Service Element -- See: ITU-T X.217
ISO 8650	Information Processing Systems -- Open Systems Interconnection -- Protocol Specification for the Association Control Service Element -- See: ITU-T X.227
ISO 8802-2	Information Processing Systems -- Local Area Networks -- Part 2: Logical Link Control
ISO 8802-3	CSMA/CD Media Access Control
ISO 8802-4	Token Bus Media Access Control
ISO 8802-5	Token Ring Media Access Control
ISO 8822	Information Processing Systems -- Open Systems Interconnection -- Connection-Oriented Presentation Service Definition -- See: ITU-T X.216
ISO 8823	Information Processing Systems -- Open Systems Interconnection -- Connection-Oriented Presentation Protocol Specification -- See: ITU-T X.226
ISO 8824	Information Processing Systems -- Open Systems Interconnection -- Specification of Abstract Syntax Notation One (ASN.1) -- See: ITU-T X.208
ISO 8825	Information Processing Systems -- Open Systems Interconnection -- Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1) -- See: ITU-T X.209
ISO 8878	Information Processing Systems -- Data Communications -- Use of X.25 to Provide

	the OSI Connection-Mode Network Service -- See: ITU-T X.223
ISO 8879	Information Processing Systems -- Standard Generalized Markup Language (SGML)
ISO 8880	Information Processing System -- Open Systems Interconnection -- Protocol Combinations to Provide and Support the OSI Network Service
ISO 8885	Information Processing Systems -- Data Communication High-Level Data Link Control (HDLC) Procedures -- General-Purpose XID Frame Information Field Content and Format
ISO 9040	Information Processing Systems -- Open Systems Interconnection -- Virtual Terminal Service
ISO 9041	Information Processing Systems -- Open Systems Interconnection -- Virtual Terminal (VT) Protocol -- Basic Class
ISO 9069	Information Processing Systems -- SGML Support Facilities -- SGML Document Interchange Format
ISO 9070	Information Processing Systems -- SGML Support Facilities -- Registration Procedures for Public Text
ISO 9314-1	Information Processing Systems -- Fibre Distributed Data Interface (FDDI) -- Part 1: Physical Layer Protocol (PHY) -- See: ANSI X3.148
ISO 9314-2	Information Processing Systems -- Fibre Distributed Data Interface (FDDI) -- Part 2: Token Ring Media Access Control (MAC) -- See: ANSI X3.139
ISO 9314-3	Information Processing Systems -- Fibre Distributed Data Interface (FDDI) -- Part 3: Physical Layer Medium Dependent (PMD) Requirements -- See: ANSI X3.166

ISO 9542	Information Processing Systems -- Telecommunications and Information Exchange Between Systems -- End System to Intermediate System Routing Exchange Protocol for Use in Conjunction with the Protocol for Providing the Connectionless-Mode Network Service
ISO 9595	Information Technology -- Open Systems Interconnection -- Common Management Information Service Definition
ISO 9596-1	Information Technology -- Open Systems Interconnection -- Common Management Information Protocol -- Part 1: Specification
ISO 9646	Open Systems Interconnection -- Conformance Testing Methodology and Framework
ISO DIS 10589	Information Processing Systems -- Intermediate System to Intermediate System Routing Protocols
ISO XXXX	Remote Operations Service Element (ROSE) (Draft)
ISP 10607 (6 Parts)	Information Technology -- International Standardized Profile AFTnn -- File Transfer, Access, and Management (Draft)
ISP 10609 (9 Parts)	Information Technology -- International Standardized Profile TB, TC, TD and TE -- Connection- Mode Transport Service Over Connection-Mode Network Service (Draft)

(Copies of ISO standards may be obtained from the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

2.3.4 Institute of Electrical and Electronics Engineers (IEEE) standards

IEEE 802.1D	MAC Bridges
IEEE P802.1G/1D	Remote MAC Bridge

IEEE 802.6	Distributed Queue Dual Bus (DQDB) Subnetwork of a Metropolitan Area Network (MAN)

(Copies of IEEE standards may be obtained from the Secretary, IEEE Standards Board, Institute of Electrical and Electronics Engineers, Inc., P.O. Box 1331, 445 Hoes Lane, Piscataway, NJ 08855-1331.)

(NOTE: IEEE 802.3, 802.4, and 802.5 are referenced as ISO 8802-3, 8802-4, and 8802-5.)

2.3.5 Requests for comment (RFC) and Internet Activities Board (IAB) standards

RFC 1157	Simple Network Management

(RFCs are available, free of charge, via e-mail using the following address: mailserv@ds.internic.net. Type "send rfcxxxx.txt" in the body.)

2.3.6 Electronic Industries Association (EIA) documents

EIA 232	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
EIA 422	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA 423	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits

(Copies of EIA standards may be obtained from ANSI or EIA, Electronic Industries Association, Engineering Department, 2001 Eye Street, Northwest, Washington, D.C. 20006.)

2.3.7 Corporation for Open Systems (COS) documents

COS VTC001	Industry Profile for Video Teleconferencing

(Copies of this document may be obtained from JIEO, Center for Standards, Fort Monmouth, NJ 07703-5613, Attention: JEBBC, Mr. Klaus Rittenbach.)

2.3.8 Bellcore documents

TR-TSV-000772	Generic System Requirements in Support of Switched Multi-megabit Data Service

(Copies of Bellcore documents may be requested from Bellcore Customer Service, 8 Corporate Place, Piscataway, NJ 08854-4156, telephone: 1-800-521-2673.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained. In addition, whenever a DoD Standardized Profile (DSP) and the associated International Standardized Profile (ISP) are listed, the DSP takes precedence.

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3. DEFINITIONS

3.1 Acronyms and abbreviations. The acronyms and abbreviations used in this standard are defined as follows:

AAL	ATM adaptation layer
ABR	available bit rate
ACK	acknowledgment
ACSE	association control service elements
A-D	analog-to-digital
ADP	automatic data processing
ADPCM	adaptive differential pulse-code modulation
AFI	authority and format identifier
AITS	Adopted Information Technology Standard
AJ	anti-jam
ALE	automatic link establishment
ANSI	American National Standards Institute
ARIDPCM	Adaptive Recursive Interpolated Differential PCM
ASCII	American Standard Code for Information Interchange
ASN.1	abstract syntax notation 1
ATDL-1	Army Tactical Data Link 1
ATM	asynchronous transfer mode
B-Channel	bearer channel
BCI	bit count integrity
BER	bit error ratio
B-ISDN	broadband-ISDN
BNZS	bipolar with N-zero substitution
bps	bit(s) per second
BPSK	binary phase-shift keying
BRI	basic rate interface
BT	broadband terminal
CBR	constant bit rate
CC	country code
CCIR	International Radio Consultation Committee
CCITT	International Telegraph and Telephone Consultative Committee (now referred to as ITU-T)
CDMA	code-division multiple access
CELP	code-excited linear prediction
CIM	Corporate Information Management
CLIP	Calling Line Identification Presentation
CLIR	Calling Line Identification Restriction
CLNS	connectionless network service

CLP	cell loss priority
CMIP	Common Management Information Protocol
CMIS	Common Management Information Services
CNR	combat net radio
COMPUSEC	computer security
COMSEC	communications security
CONS	connection-oriented network service
CONUS	continental United States
COTS	connection-oriented transport service (also, commercial off-the-shelf)
CPCS	common part convergence sublayer
CRBS	cell-relay bearer service
CRC	cyclic redundancy check
CS	convergence sublayer
CSMA/CD	carrier sense multiple access/collision detection
CSN	circuit-switched network
CVSD	continuously variable slope delta
C3I	command, control, communications, and intelligence
C4I	command, control, communications, computers, and intelligence
D	data
DAMA	demand-assignment multiple access
DBMS	database management system
D-channel	16- or 64-kbps channel for signaling and data
dc	direct current
DCA	Defense Communications Agency (now DISA)
DCAC	DCA circular
DCC	data country code
DCC	data communications channel
DCE	data circuit-terminating equipment
DCP	data communications protocol
DCPS	DoD Communications Protocol Standards
DCS	Defense Communications System
DDN	Defense Data Network
DEQPSK	differentially encoded quadrature phase-shift keying
DII	Defense Information Infrastructure
DIR	directory
DIS	Defense Information System; Draft International Standard
DISA	Defense Information Systems Agency (formerly DCA)
DISN	Defense Information System Network
DL	data link
DNS	Domain Name Service
DoD	Department of Defense
DoDISS	Department of Defense Index of Specifications

	and Standards
DPI	data processing installation
DQDB	distributed queue dual-bus
DS	directory service
DSN	Defense Switched Network
DS1	Digital Interface Rate 1 (1.544 Mbps)
DS2	Digital Interface Rate 2 (6.312 Mbps)
DS3	Digital Interface Rate 3 (44.736 Mbps)
DSP	domain-specific part
DSP	DoD standardized profile
DSS1	Digital Subscriber Signaling System Number 1
DTE	data terminal equipment
DTH	down-the-hill
DTMF	dual-tone multifrequency
ECCM	electronic counter-countermeasures
EDI	Electronic Data Interchange
EFS	error-free second
EHF	extremely high frequency
EIA	Electronic Industries Association
EMC	electromagnetic compatibility
EMSEC	emission security
ES	end system
ESF	extended superframe
ETSI	European Telecommunications Standards Institute
EW	electronic warfare
FAX	facsimile
FDDI	Fiber Distributed Data Interface
FEC	forward error correction
FED-STD	federal standard
FIPS	Federal Information Processing Standard
FRM	frame relay mode
FSK	frequency-shift keying
FTAM	file transfer, access, and management
FTP	File Transfer Protocol
Gbps	gigabit(s) per second
GFC	generic flow control
GHz	gigahertz
GNMP	Government Network Management Profile
GOSIP	Government Open Systems Interconnection Profile
GSA	General Services Administration
GSM	Special Mobile Group
H-Channel	high-rate channel
H_0-Channel	384 kbps
H_{10}-Channel	1,472 kbps

HDB3	high-density bipolar with a maximum of 3 consecutive zeros
HDLC	high-level data link control
HDTV	high-definition television
HEC	header error check
HF	high frequency
HRC	hypothetical reference circuit
HRX	hypothetical reference connection
Hz	hertz
I	imagery
IAB	Internet Activities Board
ICD	international code designator
IDI	initial domain identifier
IDP	initial domain part
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	internet protocol
IPMS	interpersonal message service
IPR	IP router
IRAC	Interdepartment Radio Advisory Committee
IS	intermediate system
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISP	International Standardized Profile
ITU	International Telecommunications Union
ITU-T	ITU-Telecommunication Standardization Sector (formerly CCITT)
IWG	interim working group
JCS	Joint Chiefs of Staff
JIEO	Joint Interoperability and Engineering Organization
JITC	Joint Interoperability Test Center
JPEG	Joint Photographic Experts Group
JTIDS	Joint Tactical Information Distribution System
kbps	kilobit(s) per second
kHz	kilohertz
km	kilometer(s)
LAN	local area network
LAP	link access procedure
LAPB	LAP balanced
LAPD	LAP on the D-channel
LDR	low data rate
LF	low frequency

LLC	logical link control
LME	layer management entity
LOS	line-of-sight
LPC	linear predictive coding
MAC	media access control
MAN	metropolitan area network
MAU	medium attachment unit
Mbps	megabit(s) per second
MCEB	Military Communications-Electronics Board
MDR	medium data rate
MF	medium frequency
MHS	message-handling service
MHz	megahertz
MIB	management information base
MIDS	Multi-Functional Information Distribution System
MILDEP	military department
MIL-HDBK	military handbook
MIL-STD	military standard
MLPP	Multi-level Precedence and Preemption
MM	military messaging
MMS	Military Messaging Service
ms	millisecond(s)
MSP	message security protocol
MSR	message storage and retrieval
MTBF	mean time between failures
MTBPM	mean time between preventive maintenance
MTP	message transfer part
MTTR	mean time to repair
mW	milliwatt(s)
MWI	message waiting indicator
n	integer
NACK	nonacknowledgment
NACSEM	National COMSEC Engineering Memorandum
NACSIM	National COMSEC Information Memorandum
NATO	North Atlantic Treaty Organization
NCC	network control center
NDI	nondevelopmental item
NE	network element
NI	nationality identifier
N-ISDN	narrowband ISDN
NIST	National Institute of Standards and Technology
NITF	National Imagery Transmission Format
NITFS	NITF standard
NLSP	network-layer security protocol
NM	network management
NNI	network-node interface

NRI	net radio interface
NSA	National Security Agency
NTIS	National Technical Information Service
OC	optical carrier level
ODA	Office Document Architecture
OS	operating system
OSI	Open Systems Interconnection
OQPSK	offset quadrature phase-shift keying
PBX	private branch exchange
PCM	pulse-code modulation
PCS	personal communications services
PDN	public data network
PDU	protocol data unit
pFS	proposed Federal Standard
PG/6	Project Group 6
PHY	Physical Layer Protocol
PLP	packet level protocol
PLRS	Position Location Reporting System
PMD	Physical Layer Medium Dependent
POH	path overhead
POSIT	Profiles for Open Systems Internetworking Technologies
ppm	part(s) per million
PRI	primary rate interface
PSK	phase-shift keying
PSN	packet-switched network
PSTN	public switched telephone network
PTI	payload type identifier
PTS	personal telecommunications service
QOS	quality-of-service
R	radio
RES	reserved
rf	radio frequency
RFC	request for comment
RM	reference model (OSI)
ROSE	remote operations service element
SAAL	AAL for signaling
SAR	segmentation and reassembly
SATCOM	satellite communications
SATURN	Second-Generation Anti-Jam Tactical UHF Radio for NATO
SCCP	signaling connection control part
SDH	synchronous digital hierarchy
SDLS	satellite data link standard
SGML	Standard Generalized Markup Language

SHF	super high frequency
SINCGARS	Single-Channel Ground and Airborne Radio System
SMFA	system management functional area
SMT	station management
SMTP	Simple Mail Transfer Protocol
SNE	subscriber network element
SNMP	Simple Network Management Protocol
SOH	synchronous optical hierarchy
SONET	synchronous optical network
SOQPSK	shaped offset quadrature phase-shift keying
SSAP	session service access point
SSCF	service-specific coordination function
SSCOP	service-specific connection-oriented protocol
SSCS	service-specific convergence sublayer
SS7	Signaling System Number 7
STANAG	standardization agreement
STM	synchronous transfer mode
STM-N	synchronous transport module - level N
STS	synchronous transport signal
TAC02	Tactical Communications Protocol 2
TADIL	tactical digital information link
TAFIM	Technical Architecture Framework for Information Management
TBD	to be determined
TC	transmission convergence
TCAP	transaction capabilities application part
TCP	transmission control protocol
TDM	time-division multiplexing
TDMA	time-division multiple access
TE	terminal equipment
TEMPEST	compromising emanations
TIA	Telecommunications Industry Association
TLSP	transport-layer security protocol
TP4	Transport Protocol class 4
TPDU	transport protocol data-unit
TR	technical report
TRANSEC	transmission security
TRI-TAC	Tri-Service Tactical Communications
TTY	teletypewriter
UDP	user datagram protocol
UHF	ultra high frequency
ULF	ultra low frequency
UMTS	Universal Mobile Telecommunications System
UNI	user-to-network interface
USAT	ultra-small aperture terminal
UTC	coordinated universal time

V	voice
VBR	variable bit rate
VCI	virtual channel indicator
VHF	very high frequency
VOX	voice-operated transmit
VPC	virtual path connection
VPI	virtual path indicator
VT	virtual terminal
VTC	video teleconferencing
WAN	wide area network
WARC	World Administrative Radio Conference
WG	working group
WNE	wide-network element
2B1Q	two binary, one quaternary

3.2 Definitions of terms. Definitions of terms used in this MIL-STD shall be as specified in Federal Standard (FED-STD)-1037. Those definitions unique to information systems, and not defined in FED-STD-1037, are provided in this section.

Broadband terminal (BT): User equipment at the location where the user-to-network interface (UNI) terminates. The BT may be a single user equipment or it may act as an aggregator of other tributary devices.

Functional profiles: A profile is defined in TR 10000 as a "set of one or more base standards, and, where applicable, the identification of chosen classes, subsets, options, and parameters of those base standards, necessary for accomplishing a particular function." The term *profile*, as used in MIL-HDBK-829, has the same meaning, as does the term *functional profile*. Profile and functional profile are used interchangeably.

Generic flow control (GFC): A bit sequence in the asynchronous transfer mode (ATM) cell header that is intended to control traffic flow into the network, to support different quality-of-service (QOS). To date, the GFC has not been defined and remains an unused field. In the interim, the field shall be all zeros.

Local-network elements: Elements that make up a base information-transfer utility for strategic users or a tactical information-transfer utility for tactical users. They include such elements as circuit and packet switches, and transmission equipment. They may also include metropolitan-area networks (MAN).

Path overhead: Overhead assigned to and transported with the SONET payload. It provides for communications between the point of creation of a SONET payload and its point of disassembly.

Reference point A: The interface between subscriber-network elements and local-network elements.

Reference point B: The interface between local-network elements and wide-network elements.

Reference point B (NATO): The interface between U.S. network elements and NATO network elements.

Strategic user: A person, organization, or other entity (including a computer or computer system) not assigned as a tactical user.

Subscriber-network elements: Elements such as terminal equipment, end systems, intermediate systems, local-area networks, metropolitan-area networks, and radio networks normally considered to be provided by the subscriber.

Tactical user: A person, organization, or other entity (including a computer or computer system) in support of a joint task force who employs the services provided by a tactical telecommunications system, or by a tactical information-processing system, for transfer of information to others.

Telnet: The virtual terminal (VT) protocol in the Internet suite of protocols that allows users of one host to log into a remote host and interact as normal terminal users of that host. The Telnet protocol is specified in IAB STD-8 (and for OSI networks in ISO 9040/9041).

Virtual Channel Indicator (VCI): Defines the explicit cell channel identification at the user-to-network interface (UNI) and network-to-node interface (NNI).

Virtual Path Indicator (VPI): Defines the explicit cell path identification at the UNI and NNI.

Wide-network elements: Elements, such as circuit switches, packet switches, and transmission equipment, that form the Defense Communications System (DCS) and public switched telephone networks (PSTN).

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4. GENERAL REQUIREMENTS

4.1 System requirements. The general system requirements in this section affect the design of subscriber-network elements (information sources, sinks, and subscriber-owned networks), local-network elements, and wide-network elements, as shown in Figure 1. The term *Defense Information System* (DIS), in Figure 1, is synonymous with the Defense Information Infrastructure (DII), except DIS does not include the operations and support staff and facilities. Figure 2 [exhibit 1-2 in the Defense Information System Network (DISN) Architecture], depicts the DII/DISN relationship, including the transform/transfer functions and information use/creation functions that are part of the terminal/computing elements. All systems fielded to satisfy Department of Defense (DoD) requirements shall comply with applicable information technology standards in the DoD Technical Reference Model, which is Volume #7 of the *Technical Architecture Framework for Information Management (TAFIM)*. Use/creation functions are addressed in detail in the DoD Technical Reference Model, and the information-transfer portion is addressed by referencing this MIL-STD.

4.1.1 End-to-end digital service. All signals entering the local- and wide-network elements shall be digital and shall remain in a digital form until the signals exit the local network at reference point A. Analog-to-digital and digital-to-analog conversion, when required, shall occur in terminal equipment or in terminal adapters. The network elements shall preserve bit count integrity (BCI) through the aggregate of network elements.

4.1.2 Circuit-switched services

4.1.2.1 Signaling. The DISN shall provide for user-to-network and user-to-user signaling, as described in 4.1.2.1.1 to 4.1.2.1.3.

4.1.2.1.1 Network-node signaling. Common-channel signaling shall be employed in local networks and wide networks. For tactical information-transfer systems, interswitch common-channel-signaling messages shall comply with MIL-STD-188-256. For base information-transfer systems and wide networks, interswitch common-channel-signaling messages shall comply with ANSI T1.111, T1.112, T1.113, and T1.114 for Signaling System Number 7 (SS7), as modified, to provide the military enhancements described in mandatory Appendix A, titled *DSN7 Common Channel Signaling*. For broadband networks, signaling messages shall comply with ITU-T Q.2761 to Q.2764, and other applicable standards and implementation agreements as they become available.

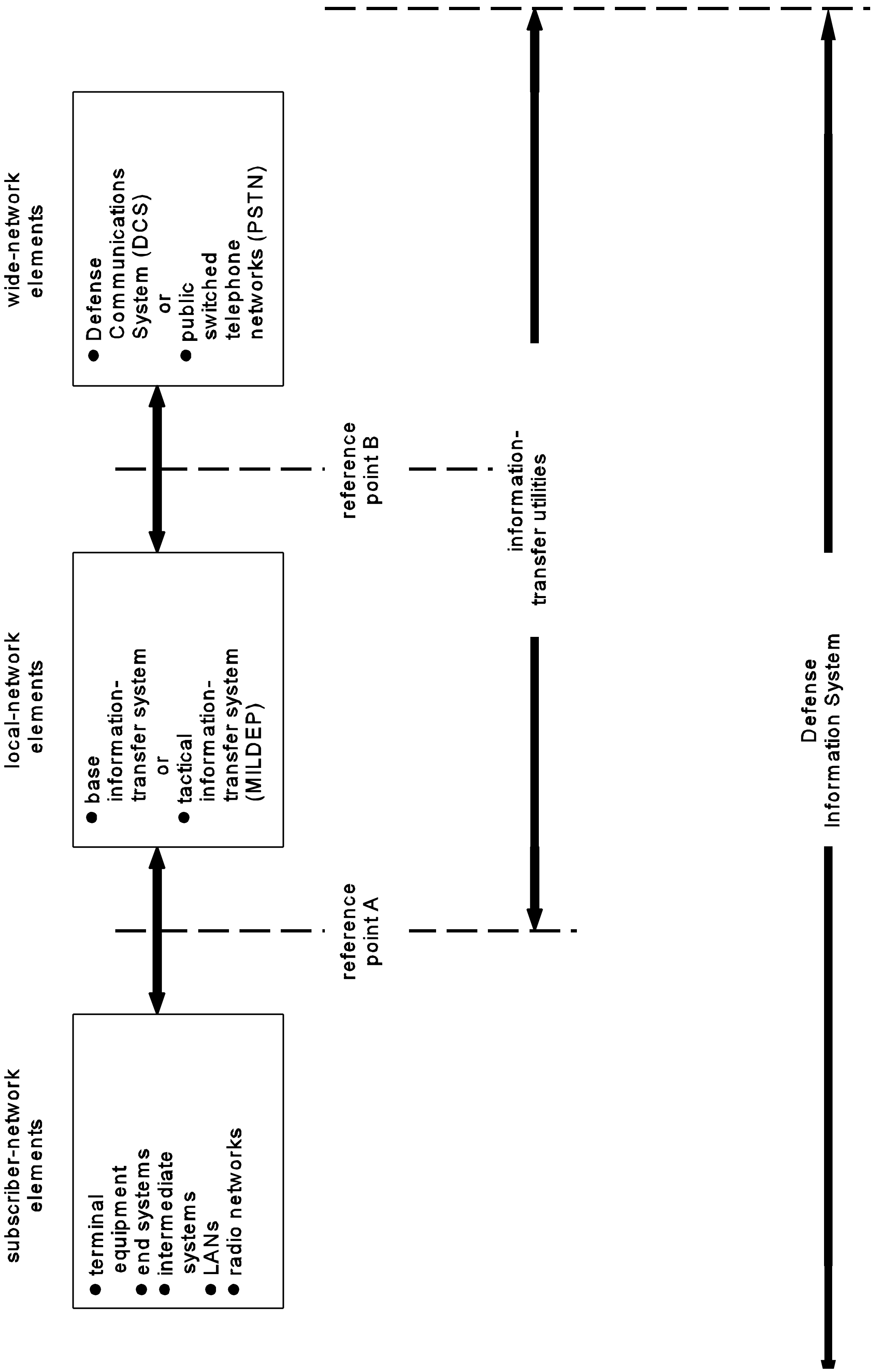


FIGURE 1. DIS framework.

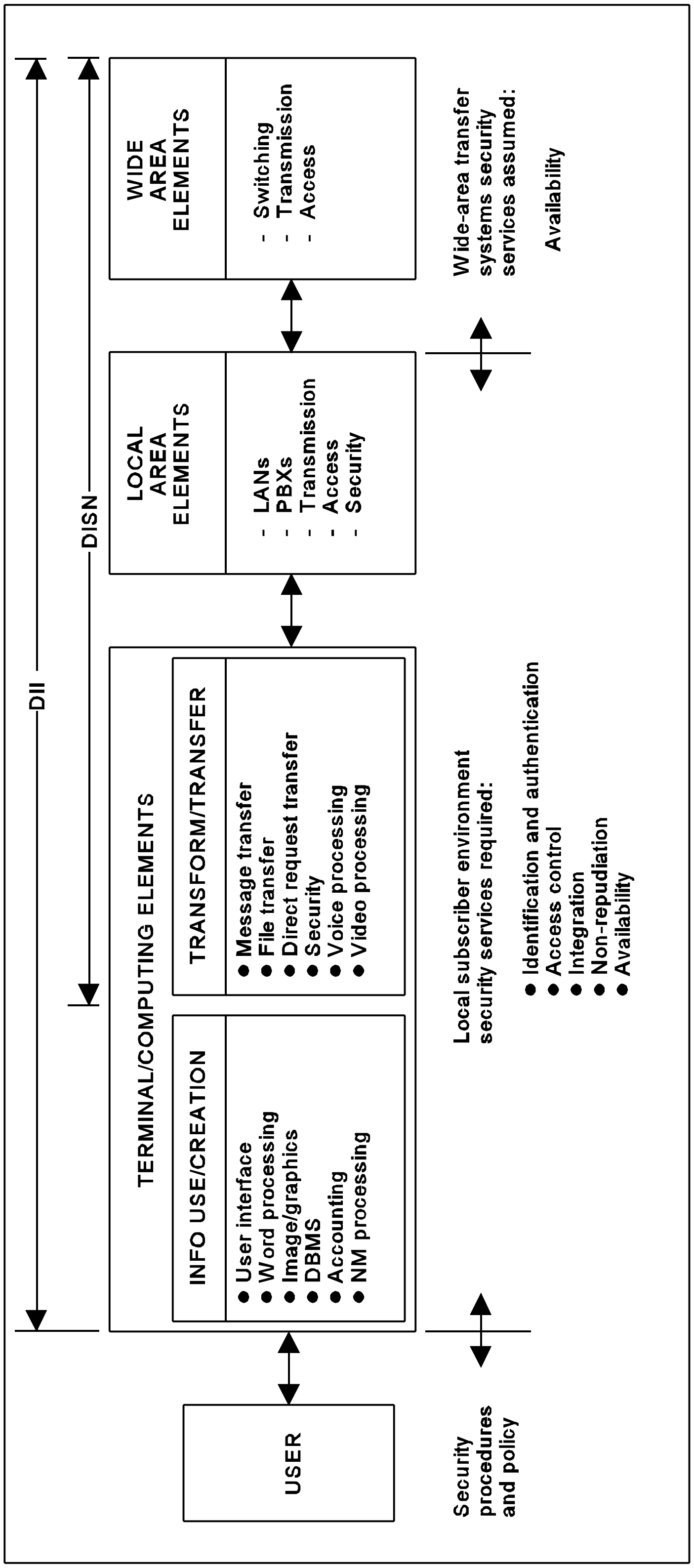


Figure 2. DISN relationship to DII.

4.1.2.1.2 User-to-network signaling

a. Common-channel signaling shall be employed at the user-to-network interface in base information-transfer systems. User-to-network signaling messages shall comply with the following ANSI standards:

(1) ANSI T1.602

(2) ANSI T1.607

(3) ANSI T1.608

(4) ANSI T1.610

b. In-band signaling shall be employed at the user-to-network interface in tactical information-transfer systems. User-to-network signaling messages shall comply with MIL-STD-188-256.

c. For asynchronous transfer mode (ATM) networks, user-to-network signaling messages shall share the same transmission facility used to carry traffic. User-to-network signaling messages shall comply with ITU-T Q.2931.

4.1.2.1.3 User-to-user signaling. User-to-user signaling is the control information exchanged between users' terminal equipment. This information may be transmitted in the signaling and the information bearer channels, but shall be transparent to network elements. The user-to-user information element is used to establish end-to-end encrypted calls between tactical and strategic users, as defined in MIL-STD-188-105.

4.1.3 Packet data service. Packet data service may be provided by different types of packet networks including X.25 packet-switched networks, LANs, and IP Router networks. Figure 3 illustrates how TCP/IP will be used to achieve interoperability between DTEs in different networks.

4.1.3.1 DTE direct access. Packet data services may be delivered by means of data terminal equipment (DTE) directly connected to packet-switched networks. X.25 packet-switched networks shall conform to the Internet Transport Profile for DoD communications, as specified in MIL-STD-2045-14502-3.

4.1.3.2 LAN access. For LAN access, DTEs must match the LAN physical layer as well as the layer 2 sublayers, the Logical Link Control (LLC) and Media Access Control (MAC). DTEs connected to the LAN may exchange packets with other DTEs connected to the

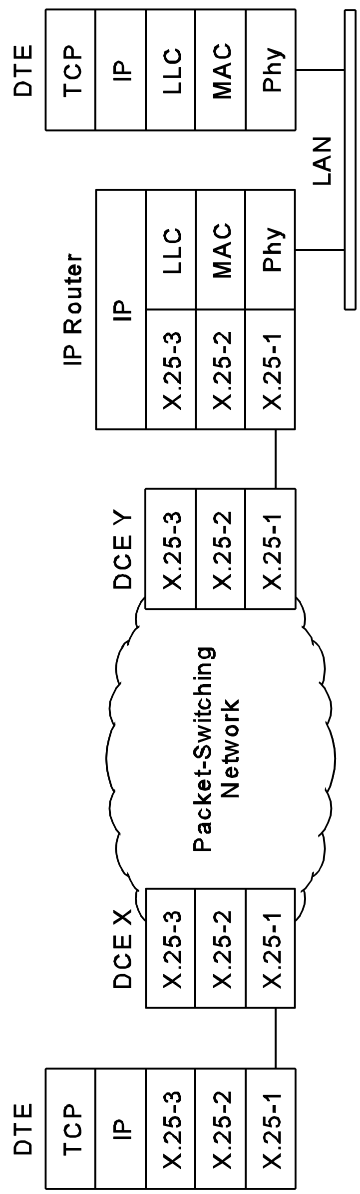


FIGURE 3. Internetworking using TCP/IP.

same LAN. LAN access shall conform to the Internet Transport profiles for DoD communications, as specified in MIL-STD-2045-14502-4 for media-independent requirements and in MIL-STD-2045-14502-5 for media-dependent requirements.

4.1.3.3 DTE interoperability. For DTEs to connect to other DTEs on different subnetworks, the transmission control protocol/internet protocol (TCP/IP) suite, as specified in MIL-STD-2045-14502-1, shall be used. TCP is a connection-oriented transport protocol that ensures reliable end-to-end data service. IP is a connectionless internet protocol that enables interconnection of subnetworks into an internetwork, independent of any particular subnetwork technology, and is used in gateways and routers between subnetworks. The TCP/IP suite includes common applications such as electronic mail, file transfer, and remote login, to aid DTE interoperability.

4.1.3.4 IP router networks. DDN X.25 networks are being phased out and replaced by IP router networks. IP routers perform routing and gateway functions needed to pass packets between different subnetworks and other routers. IP addresses include the address for the subnetwork and DTEs on that subnetwork; therefore, IP routers route packets based on the destination subnetwork address, not the destination DTE address. IP routers can exist at any place within the DII as either interior or exterior gateways. For the purpose of routing, a group of networks and gateways controlled by a single administrative authority is called an autonomous system, using interior gateway protocols. Gateways between autonomous systems use exterior gateways protocols.

4.1.3.5 IP addressing. Currently, IP provides only 32 bits of address space and is facing an inability to provide unique IP addresses to all entities that require them. Work is ongoing on a next-generation protocol (IPng) to resolve this issue.

4.1.3.6 ATM networks. In the future ATM networks will provide the transport service between IP routers. IP datagrams will be segmented into ATM cells at the sending ATM-network interface and reconstructed from ATM cells at the receiving ATM-network interface.

4.1.3.7 Switched multi-megabit data service. Switched multi-megabit data service (SMDS), a Bellcore proprietary development, provides connectionless datagram transfer service. The SMDS variable-length data units are segmented into 53-byte cells for transmission. SMDS addressing uses the ITU-T E.164 numbering plan. Open-commercial standards for the SMDS subscriber network interface have not been developed. Details are provided in Bellcore TR-TSV-000772.

4.1.3.8 Point-to-point access. For point-to-point access, DTEs must match the physical layer as well as the data link layer. Point-to-point access shall conform to the internet transport profile for DoD communications, as specified in MIL-STD-2045-14502-2.

4.1.4 Personal communications services (PCS). *Personal communications services* is defined as a set of capabilities that allows some combination of terminal mobility, personal mobility, and service profile management. Figure 4 shows all system components needed to support PCS. The DISN shall implement personal communications services using the currently emerging commercial standards.

4.1.4.1 Terminal mobility. Terminal mobility is based on wireless access to the network. It allows a mobile terminal, which moves with its user, to gain access to the network from different locations. To support terminal mobility, the network must be able to identify calling wireless terminals and locate called wireless terminals. In Figure 4 terminal, mobility is represented by the vehicular and hand-held terminals shown on the left. Terminal mobility shall be provided initially within each base communications and Joint Tactical Headquarters area. Eventually, global terminal mobility shall be provided across these areas, consistent with the commercial standards for Future Public Land Mobile Telecommunication Systems and Universal Personal Telecommunications.

4.1.4.1.1 Wireless access. Wireless access involves the wireless link (air interface) between the mobile terminal and the base station (radio port), management of the wireless links provided by several base stations by a central base station controller, and the interface between the base station controller and the switched network. In Figure 4, wireless access is represented by the base stations and the base station controller shown in the center.

4.1.4.2 Personal mobility. Personal mobility allows users of telecommunication services to gain access to these services from any convenient terminal with which they choose to associate themselves. To support personal mobility, the network must be able to distinguish between terminal and personal identifiers; to keep track of current user-terminal associations, user locations, services authorized to the user, and service capabilities of the terminals; and to maintain the user's call/service account. Personal mobility may be provided by either wireline or wireless terminals. In the lower right of Figure 4, personal mobility is represented by the two fixed terminals and the user moving between them. Personal mobility shall be provided globally across all DISN terminals.

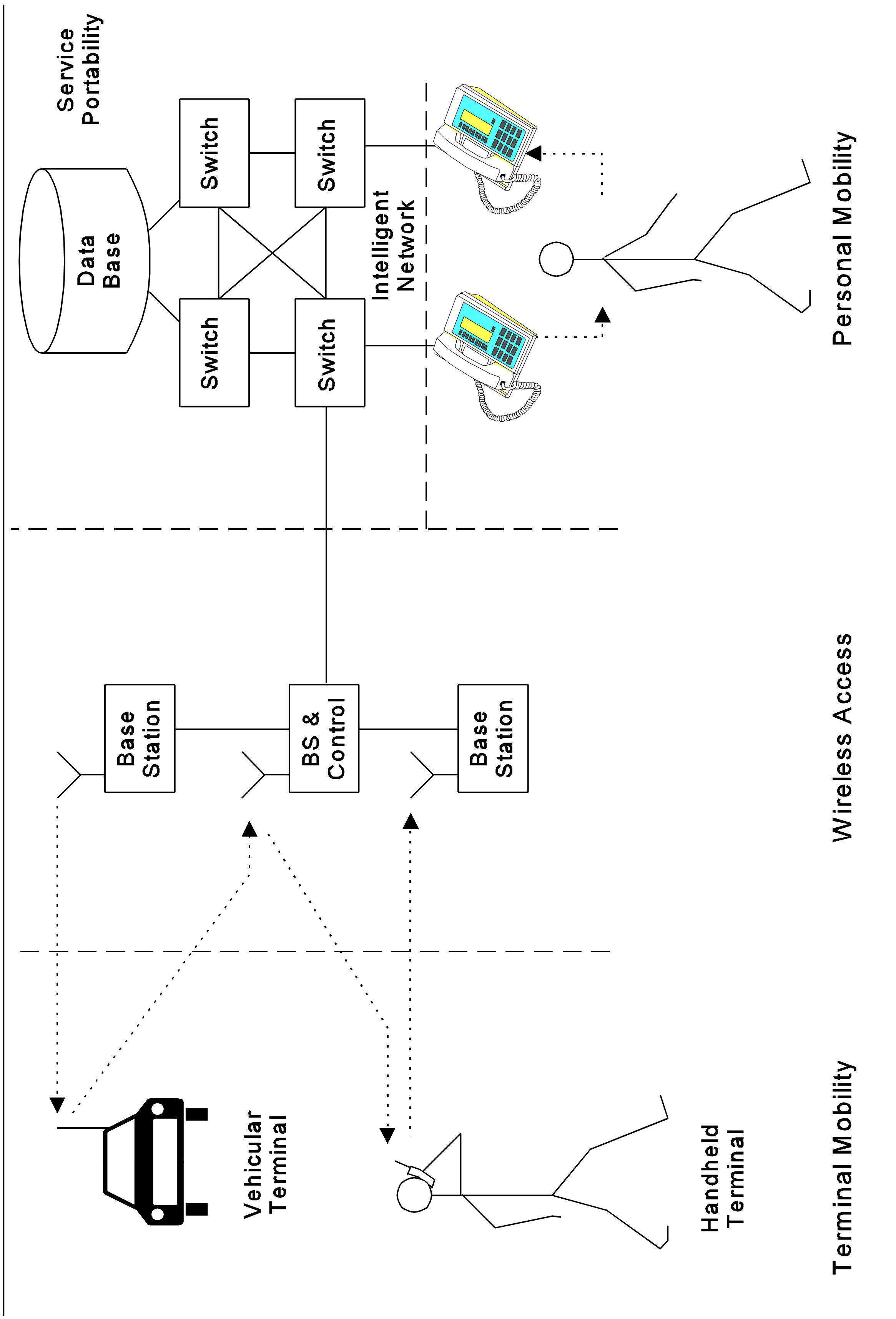


FIGURE 4. Personal communications services.

4.1.4.3 Universal access. Universal access is the combination of both terminal and personal mobility, including the ability of wireless terminal users to move between different wireless access areas. The term *intelligent network* implies the capabilities needed to support universal access. An intelligent network must contain a central or distributed database and perform service profile management. Service profile management maintains the home (normal) location of users, the location they are currently visiting, the identity of the terminal with which they are currently associated, their currently authorized services, their service use records, and the service capabilities of each terminal and wireless access area. Additionally, the signaling system used in an intelligent network must be able to rapidly interrogate this database without causing undue delays or a substantial increase in communications traffic. The key components of an intelligent network are shown in the upper right of Figure 4. The DISN shall be enhanced, commensurate with commercial developments, to support intelligent network requirements and universal access.

4.1.5 Dedicated circuits. The DISN shall be able to provide dedicated circuits at 64-kbps, 384-kbps, and 1.544-Mbps rates. These circuits shall be provided by commercially leased lines or by multiplexing existing channels into dedicated through groups. The layer 1 interface shall conform to applicable portions of 5.1.1.1.1 for the 64-kbps rate, and 5.1.2.1.1 for both the 384-kbps and 1.544-Mbps rates.

4.1.6 Subscriber services. Local-network elements shall provide telecommunications subscriber services for circuit-switched voice, circuit-switched data, and packet-switched data. Services supported include voice telephony, data transmission, facsimile, record traffic, video, and multimedia communications.

4.1.6.1 Voice services. The aggregate of tactical-network elements, wide-network elements, and base-level network elements shall provide the capability for both nonsecure and end-to-end encrypted voice calls between subscribers at a military base and subscribers in a tactical system. A discussion of nonsecure voice calls is described in 4.1.6.1.2; end-to-end encrypted voice calls are discussed in 4.1.6.1.3.

4.1.6.1.1 Voice digitization. The following voice digitization algorithms shall be used:

a. Base information-transfer systems shall use 64-kbps PCM (mu-law companding), as defined in ITU G.711, Tables 2a and 2b.

b. Tactical information-transfer systems shall be able to interface either directly or via a switch, using 16-kbps continuously variable slope delta (CVSD) modulation, as defined in MIL-STD-188-113, the section titled *CVSD modulation*. Tactical systems employing 32-kbps digital loops shall double-sample 16-kbps CVSD signals to achieve joint interoperability.

c. Narrowband voice subscribers connected to the local network through high frequency (HF) radio, special electronic counter-countermeasures (ECCM) radios, or other narrow-bandwidth facilities shall use 2.4-kbps linear predictive coding (LPC), as defined in MIL-STD-188-113, the section titled *LPC*; or 4.8-kbps code-excited linear prediction (CELP), as defined in FED-STD-1016.

d. Digital voice encoders employing 32-kbps adaptive differential pulse-code modulation (ADPCM) shall conform to ITU-T G.721.

4.1.6.1.2 Nonsecure voice service. The Integrated Services Digital Network (ISDN) and tactical telephone terminals use different voice-encoding algorithms and different bit rates dictated by the bandwidth of the transmission equipment used in DoD networks. Base telephone terminals use 64-kbps PCM voice encoding. Tactical telephone terminals use 16-kbps CVSD (optionally 32-kbps CVSD) voice encoding. For nonsecure voice calls between subscribers at a military base and subscribers in a tactical network, transcoding will be done at the internetwork gateway to convert from 64-kbps PCM to 16-kbps CVSD (optionally 32-kbps CVSD), and from 16-kbps CVSD (optionally 32-kbps) to 64-kbps PCM, as described in MIL-STD-188-105, the two sections titled *Transcoding*.

4.1.6.1.3 End-to-end encrypted voice service. End-to-end encrypted voice service between tactical and strategic networks shall be available if the subscriber terminals contain a common voice-encoding algorithm and a common crypto algorithm, and are capable of mode negotiation. End-to-end encrypted voice calls shall be treated as a data service. BCI shall be preserved to maintain cryptographic synchronization between calling and called secure-voice terminals. End-to-end encrypted voice calls between base-level and tactical users may occur at any standard bit rate up to and including 16 kbps (optionally 32 kbps), as described in MIL-STD-188-105, the section titled *End-to-end encrypted telephone service*. The network elements shall allow switching from data-to-voice and voice-to-data to occur at the terminals.

NOTE: The 32-kbps CVSD option will work only for special cases in which calls do not transit subnetworks that use 16-kbps channels.

4.1.6.1.3.1 Mode negotiation. New telephone terminals used in ISDN networks will be able to negotiate, during the call-establishment phase, to determine if a common voice-encoding mode exists. The new telephone terminal shall comply with MIL-STD-188-105, the section titled *New terminal*, and addressed by the National Security Agency (NSA) in their

Secure Terminal Equipment Program. When used in ISDN networks, mode negotiation shall be accomplished using the user-to-user information element, as described in MIL-STD-188-105, the section titled *Call-establishment phase*.

4.1.6.1.3.2 Interoperable modes. New telephone terminals, as defined in MIL-STD-188-105, shall have at least two voice-encoding modes. One will be PCM, which will be used in ISDN networks, as defined in FIPS-PUB 182. Another will be CVSD-16, which will be used for end-to-end encrypted calls between tactical and strategic users. Other voice-encoding schemes may be 32-kbps ADPCM, 2.4-kbps LPC-10, and 4.8-kbps CELP.

4.1.6.1.3.3 End-to-end encrypted voice service in ATM networks. End-to-end encrypted voice service shall use AAL 1 CBR service (see 5.4.3.3.3) for access to and exit from ATM networks, to maintain BCI. The AAL 1 protocol may be implemented in either the telephone terminal or a terminal adapter. The terminal adapter may be located in the ATM switch.

4.1.6.1.4 Rate adaptation

a. Information sources, linked to a strategic-local network, that operate at rates of 600, 1200, 2400, 4800, 9600, 16000, 19200, or 32000 bps, shall be rate-adapted to a 64-kbps channel. The rate adaptation of bit rates up to 32 kbps shall use the multi-stage approach defined in ITU-T V.110, the section titled *Adaptation of V-series data signaling rates to the intermediate rates*. With this approach, rates of 4.8 kbps and below are mapped to 8 kbps, 9.6 kbps is mapped to 16 kbps, and 19.2 kbps is mapped to 32 kbps. Rate adaptation of 8-, 16-, and 32-kbps signals shall be rate-adapted in accordance with the following procedure, as documented in ITU-T I.460, the section titled *Rate adaptation of 8-, 16-, and 32-kbps streams*:

(1) The 8-kbps stream occupies bit position 1.

(2) The 16-kbps stream occupies bit positions 1 and 2.

(3) The 32-kbps stream occupies bit positions 1, 2, 3, and 4.

(4) All unused bit positions shall be set to "1."

(5) The order of bit transmission of the subrate stream shall be identical before and after rate adaptation.

b. Information sources, linked to a tactical network, that operate at rates of 75, 600, 1200, 2400, 4800, or 9600 bps, shall be rate-adapted to a 16-kbps channel, as described in MIL-STD-188-216, the section titled *Multisampling*.

4.1.6.2 Data services. The aggregate of tactical-network elements, wide-network elements, and base-level network elements shall provide the capability for end-to-end data service such as interactive, video, and imagery data. The data service shall be supported by internet protocols; open system interconnection protocols; or any combination of both protocols over packet, frame, and cell switching, or router networks. The separation of traffic by classification shall be provided by (1) physical separation through network segmentation; (2) end-to-end encryption, wherein the keys associated with the encryption are protected as a minimum to the same level as the classification of the traffic that they handle; or (3) a combination of both. Authentication of nonsecure dial-up subscribers shall be provided by NSA- approved non-forgeable dynamic-token-based authentication technology. Authentication of secure dial-up subscribers and encryption of their traffic shall be provided through the use of NSA-approved secure terminal equipment (STE).

4.1.6.3 Video services. Circuit-switched networks shall support video services by allocating multiple channels (or timeslots) as required to provide sufficient bandwidth for video signals. This service will support nx64-kbps operation (where 1<n<23) for base networks and mx16-kbps (where 1<m<16) for tactical networks. The bandwidth provided for video services between strategic and tactical networks may be limited by the tactical networks. The procedure for converting 64-kbps to 16-kbps channels is provided in MIL-STD-188-105 w/notice of change.

4.1.6.4 Multimedia communications. Network access and signaling functions shall support multimedia services. Multimedia services provide the capability to manipulate and manage information consisting of text, graphics, images, video, and audio. These services can be used directly by mission area applications and by other support applications, as described in the TAFIM. Addition and deletion of types of information during an active multimedia session shall be supported.

4.1.6.5 Supplementary services. A network supplies supplementary services in addition to its basic services. The generic procedures applicable to the control of supplementary services at the user-to-network interface are defined in ANSI T1.610. The mandatory supplementary services, which are applicable to both fixed and deployed networks, are discussed in 4.1.6.5.1 to 4.1.6.5.3. The optional supplementary services are discussed in 4.1.6.5.4 to 4.1.6.5.17.

4.1.6.5.1 Multi-level Precedence and Preemption. The Multi-level Precedence and Preemption (MLPP) service provides a prioritized call-handling service. This service has two parts: precedence and preemption. Precedence involves assigning a priority level to a call. Preemption involves the seizing of resources, which are in use by a call of lower precedence, by a higher-level precedence call in the absence of idle resources. The MLPP service is a network provider's option applicable to a domain of the network, that is, all subscribers and the network and access resources that belong to the domain. Connections and resources belonging to calls from MLPP subscribers shall be marked with a precedence level and domain identifier and shall be preempted only by calls of a higher precedence from MLPP users in the same domain. Connections and resources belonging to calls from non-MLPP users and users from other MLPP domains shall not be preempted. The maximum precedence level of a subscriber will be set by the service provider, based on the subscriber's need. The subscriber may select a precedence level up to and including the maximum subscribed-to precedence level on a per-call basis. The MLPP service shall be mandatory in DoD networks (both fixed and deployed) and shall comply with ANSI T1.619. For calls to subscribers in existing deployed (tactical) networks that comply with Tri-Service Tactical Communications (TRI-TAC) specifications, the MLPP service shall comply with MIL-STD-188-105.

4.1.6.5.2 Preset Conference. The Preset Conference service allows the served user to quickly establish a conference call with a predetermined list of conferees stored in the network. All of the call attempts are done in parallel. This service is defined in ANSI Draft T1S1.2/94-311.

4.1.6.5.3 Hotline. The Hotline service allows a user to automatically initiate a call, act as a receiver for Hotline service calls, or do both. Three subscription options exist for the Hotline service: Protected Hotline Calling service, Unprotected Hotline Calling service, and Protected Hotline Receiving service. When subscribing to the Protected Hotline Calling service, the user shall initiate calls only to the predetermined called party. In addition, the Protected Hotline Calling service user will not receive calls from any third party and may receive calls only from the predetermined called party, if that predetermined called party is also a Hotline service user. When subscribing to the Unprotected Hotline Calling service, the user shall initiate calls only to the predetermined called party of the Hotline service call, who may or may not be another Hotline service user; however, the Hotline service user may receive calls from third parties in addition to calls from the called party of the Hotline service call. A protected Hotline Receiving service user may receive calls only from predetermined Hotline Calling service user(s); however, the user may initiate calls to other users. This service is defined in ANSI Draft T1S1.2/91-408.

4.1.6.5.4 Call Waiting. The Call Waiting service permits a subscriber to be notified of an incoming call with an indication that no interface information channel is available. The subscriber then has the choice of accepting, rejecting, or ignoring the waiting call. This service is defined in ANSI T1.613.

4.1.6.5.5 Call Hold. The Call Hold service allows a user to interrupt communications on an existing call and then subsequently, if desired, reestablish communications. This service is defined in ANSI T1.616.

4.1.6.5.6 Call Forwarding. The Call Forwarding service allows a served user to have the network send to another number all incoming calls for the served user's number. This service is defined in ITU-T I.252.

4.1.6.5.7 Normal Call Transfer. The Normal Call Transfer service allows a user to transfer an established call to a third party. This service is defined in ANSI T1.632.

4.1.6.5.8 Conference Call. The Conference Call service allows a user to establish calls to multiple parties, one at a time, using normal call-handling procedures. The parties may also communicate among themselves. This service is defined in ITU-T I.254, the section titled I.254.1 - Conference Calling Service Description.

4.1.6.5.9 User-to-User Signaling. The User-to-User Signaling service allows users to send and receive limited amounts of user- generated information to and from another user-network interface. This information is passed transparently (without changing contents) through the network. Users can transfer information during the establishment and clearing phases of calls. The information is transmitted in the user-user information element. The user-user information element is an optional element of the following Digital Subscriber Signaling System Number 1 (DSS1) types of messages: Alerting, Connect, Disconnect, Progress, Release, Release Complete, and Setup. This service is defined in ANSI T1.621.

4.1.6.5.10 Calling Line Identification Presentation. The Calling Line Identification Presentation (CLIP) service provides the called party with the calling line identification at call setup on all incoming calls. This service applies to both basic rate and primary rate interfaces. This service is defined in ANSI T1.625.

4.1.6.5.11 Calling Line Identification Restriction. The Calling Line Identification Restriction (CLIR) service notifies the network that the Calling Party Number is not allowed to be presented to the called party. This service is defined in ANSI T1.625. This service applies to both basic rate and primary rate interfaces.

4.1.6.5.12 Call Completion to a Busy Subscriber. The Call Completion to a Busy Subscriber service allows an authorized user, A, who encounters a busy destination, B, to be notified when the busy destination, B, becomes idle. The network reinitiates the call to destination B if user A desires. This service is defined in ANSI Drafts T1S1.1/92-253 and T1S1.2/92-323.

4.1.6.5.13 Message Waiting Indicator Control and Notification. The Message Waiting Indicator (MWI) Control and Notification service is provided by the network to a Message Storage and Retrieval (MSR) System provider. The MSR system may request the network to provide an indication to one of its client users that messages are waiting at the MSR system. This service is defined in ANSI T1.622.

4.1.6.5.14 Line Hunting. The Line Hunting service allows a served user to enable incoming calls to a specific ISDN number to cause a search for an available hunt group member to which calls can complete. This service may be made available on demand or by subscription. This service applies to both basic rate and primary rate interfaces. This service is defined in ANSI Draft T1S1.1/92-188.

4.1.6.5.15 Explicit Call Transfer. The Explicit Call Transfer service allows a service user having two independent calls to connect together the distant parties of the two calls, thereby releasing the served user from the call, in a single user-network interaction. This service applies to both basic rate and primary rate interfaces. This service is defined in ANSI Draft T1S1/94-553.

4.1.6.5.16 Call Park. The Call Park service allows a service user to interrupt a speech or voice band data communication on an existing call, and then, re-establish communications from the same or different terminal equipment within the same Call Park Subscriber Group. A Call Park Subscribers Group is a group of Call Park subscribers designated by the service provider. The service provider may optionally group together Call Park subscribers into a Call Park Subscriber Group, in order to provide a measure of security. This service applies to the basic rate interface. Call Park is a circuit switch voice service with similar characteristics of Call Hold, except for the ability to re-establish communications from different terminal equipment. This service is defined in ANSI Draft T1S1/LB 95.05.

4.1.6.5.17 Call Deflection. The Call Deflection service permits a served user to respond to an offered call with a request to deflect the call to another number. As a subscription option, the subscriber can invoke the deflection request after answering the call. In addition, the subscriber can limit the time it takes for the deflected-to user to answer the call. If the deflected-to user does not answer within a specified time interval, the network stops the deflection attempt and returns a failure indication to the deflecting user, if the deflecting user is still associated with the call. Unlike Call Forwarding, Call Deflection allows the network to redirect a call only after receipt of a specific user request to deflect that call. This service is defined in ANSI T1.642.

4.2 Information-transfer utility system parameters. The following ISDN system parameters listed in 4.2.1 through 4.2.5 shall apply to the information-transfer utilities portion of the DISN. These parameters are summarized here because of their impact on the design of information sources, sinks, and processors that exchange information through information-transfer utilities.

4.2.1 Information bearer channels. Base information-transfer systems shall be able to exchange multiple bearer channels over a single connection at reference point A. Below are four interface options:

a. Basic rate interface. The basic rate interface provides two 64-kbps bearer (B-) channels and one 16-kbps signaling data (D-) channel. B-channels can be used for voice or data. The D-channel is used for call control and low-speed packet data. The required method for multiplexing the 2B+D channels into a form suitable for transmission over a single twisted wire pair is provided in 5.1.1.1.1.

b. Primary rate interface. The primary rate interface provides a combination of 23B- (or 30B-) channels and one 64-kbps D-channel. The 23B+D (or 30B+D) channels will be used primarily to connect private branch exchanges (PBX) to central offices at reference point A. The primary rate interface will also be used at reference point B to interconnect local-network elements to wide-network elements. A D-channel may not be required for every primary rate interface; in this case, all 24 or 31 channels shall be available for use as B-channels.

c. High-rate channels. It shall be possible to treat multiple 64-kbps channels as a single high-rate (H) channel. Six B-channels can be treated as a single 384-kbps (H_0) channel. Twenty-three B-channels can be treated as a single 1472-kbps (H_{10}) channel. H_0 channels can be used in combination with B-channels on the same primary rate interface (PRI). Rules for time-slot assignments for high-rate signals are provided in 5.1.2.1.1.j.

d. Broadband services interface. See 5.4.

4.2.2 Timing and synchronization

4.2.2.1 Reference point A. In general, information-source bit timing shall be slaved to the local network, as described in MIL-STD-188-115, the discussion of master-slave operation. Terminal equipment connected to network elements in the base information-transfer system shall comply with ANSI T1.601, the section titled *Baud Rate, Timing, and Synchronization*. Terminal equipment connected to network elements in the tactical information-transfer system shall comply with MIL-STD-188-115.

4.2.2.2 Reference point B. Local-network and wide-network elements that provide the reference point B interface shall provide stratum 1 clock accuracy, as defined in ANSI T1.101 and ITU-T G.811, and buffering sufficient to maintain BCI for a minimum of 24 hours. Frame synchronization, as required to demultiplex time-division-multiplexed signals, shall be provided by use of the framing bits described in ANSI T1.408 and MIL-STD-188-202.

4.2.2.3 Coordinated universal time. Systems that require time and frequency reference information based on coordinated universal time (UTC) shall comply with FED-STD-1002.

4.2.3 Tactical-to-strategic gateway functions. Gateways are a necessary solution for the interoperability of near-term tactical and strategic networks. Reference point B shall include a wide-network gateway function to achieve interoperability between switched subscribers in tactical information-transfer systems and base information-transfer systems. The gateway function requires standards for layers 1 to 3 for tactical systems using 16-kbps channels (optionally 32-kbps) and strategic systems using 64-kbps channels, as described in MIL-STD-188-105, sections 5.2 and 5.3. Since end-to-end encryption is a long-term objective of this MIL-STD, the use of gateways that require reencryption should be minimized. Gateway functions for circuit- and packet-switched connections are described in 4.2.3.1 and 4.2.3.2.

4.2.3.1 Circuit-switched voice and data. The gateway function shall include the capability to convert voice algorithms used in tactical information-transfer systems to 64-kbps pulse-code modulation (PCM) used in base information-transfer systems, in accordance with MIL-STD-188-105, section 5.5. The gateway function shall also be capable of rate adaptation, in accordance with MIL-STD-188-105, sections 5.6 and 5.9. The gateway function shall be able to accommodate additional conversion algorithms if needed in the future. The gateway function shall include the signaling-message converter, defined in MIL-STD-188-105, section 5.4, to allow tactical-switched systems to internetwork with strategic-switched systems. The signaling messages shall be examined by the gateway function. If it is determined that a secure voice or data call is being established, the gateway function shall use rate adaptation at the interface, in accordance with 4.1.6.1.4. Permanent and semipermanent circuits shall enable data transfer across the gateway at multiples of 16 kbps, up to 512 kbps, in accordance with MIL-STD-188-105, section 5.9. BCI shall be maintained.

4.2.3.2 Packet-switched data. The gateway function shall enable packet-switched data transfer across the gateway at multiples of 16 kbps, up to 512 kbps, in accordance with MIL-STD-188-105, section 5.9. BCI shall be maintained.

4.2.4 System performance. System performance standards for base information-transfer systems and wide networks shall be based on the standards for 64-kbps channels, as given in 5.7. System performance standards for tactical information-transfer systems shall be based on 5.7.

4.2.5 Network management. The Simple Network Management Protocol (SNMP), as defined in RFC 1157, shall be used until it is superseded by the Common Management Information Protocol (CMIP)/Common Management Information Service (CMIS). The objective of DISN network management is to conform to the Government Network Management Profile (GNMP) (FIPS-PUB-179), and to support the establishment, reconfiguration, and maintenance of a stable signaling and user-network environment. To achieve this objective, network management entities within each segment of the DISN shall be based on an integrated management architecture and shall employ a set of common management protocols, as defined in MIL-STD-2045-38000 and its comparison MIL-HDBK-1351. DISN network management shall provide support for the following set of common management application functions:

a. Fault management

b. Configuration management

c. Account management

d. Performance management

e. Security management

Maximum use shall be made of automated management aids to ensure effective and responsive DISN network management. Section 5.6 defines specific DISN network management requirements.

4.3 Common requirements. DISN equipment will be used in a variety of applications and environments. Acquisition specifications should contain design requirements tailored to the expected application and environment; however, the nature of military operations also dictates some degree of flexibility. Extreme care must be taken to ensure that design requirements selected from applicable DoD documents are tailored to provide the necessary flexibility. The use of commercial off-the-shelf (COTS) equipment is encouraged when the acquisition authority determines that some or all of the common requirements listed in 4.3.1 to 4.3.13 do not apply.

4.3.1 Information security. The design of information systems shall allow the incorporation of communications security (COMSEC) and computer security (COMPUSEC) to protect information against unauthorized disclosure, transfer, modification, or destruction.

4.3.1.1 Communications security. Provisions for COMSEC shall include crypto security, transmission security (TRANSEC), emission security (EMSEC), and physical security.

4.3.1.1.1 Crypto security. Information systems shall provide internal or external crypto equipment. Digital interfaces to external crypto equipment shall be in accordance with MIL-STD-188-114.

4.3.1.1.2 Transmission security. HF radio anti-jam (AJ) systems shall comply with the TRANSEC algorithm provisions in MIL-STD-188-148. Very high frequency (VHF) radios shall comply with Joint Interoperability and Engineering Organization (JIEO) Specification 9001. Ultra high frequency (UHF) radios shall comply with Standardization Agreement (STANAG) 4372. Standards for satellite communications (SATCOM) AJ systems shall be based on existing UHF, super high frequency (SHF), and extremely high frequency (EHF) common-user DoD satellite systems.

4.3.1.1.3 Emission security. Compromising emanations shall be controlled within applicable TEMPEST criteria in the current edition of NSTISSAM TEMPEST/1-91.

NOTE: National COMSEC Engineering Memorandum (NACSEM) 5201 provides design guidance and MIL-HDBK-232 provides installation guidelines for compromising emanations.

4.3.1.1.4 Physical security. Systems shall have appropriate tamper-resistant design features and tamper-detection mechanisms.

4.3.1.2 Computer security. Computer systems shall comply with applicable provisions of DoD 5200.28-STD and the security standards identified in the TAFIM.

4.3.2 Electromagnetic compatibility. Systems and associated subsystems shall be designed to achieve intrasystem and intersystem electromagnetic compatibility (EMC). There shall be no emissions by any item of the subsystem or system beyond the tolerances established in MIL-STD-461. Techniques used to measure and determine EMC characteristics shall comply with the applicable requirements of MIL-STD-462. Equipment and subsystems should be designed in accordance with applicable EMC guidance in MIL-HDBK-235, MIL-HDBK-237, MIL-HDBK-241, and MIL-HDBK-253. The EMC program must address both emissions and susceptibilities, not just emissions. Future specific electromagnetic emission requirements will require tailoring of MIL-STD-461 requirements to ensure compatibility.

NOTE: MIL-HDBK-237 provides guidance for implementing an EMC program, and MIL-HDBK-241 provides guidance for EMC enhancement (electromagnetic interference reduction) of equipment power supplies.

4.3.3 Electronic warfare vulnerability and electronic counter-countermeasures capabilities. Electronic warfare (EW) vulnerability analyses shall be performed on all radio subsystems, beginning with the concept formulation stage. Appropriate electronic counter-

countermeasures (ECCM) capabilities shall be developed to protect these systems from the applicable EW threat.

4.3.3.1 Determining the electronic warfare technical threat. EW intelligence sources shall be used to provide an EW technical threat model during the concept formulation stage of system development. The EW technical threat model shall determine if 4.3.3.2 and 4.3.3.3 are required.

4.3.3.2 Analyzing electronic warfare vulnerability. Simulation techniques should be used to assess the effects of EW on radio links. Preliminary analyses of EW effects on candidate systems should be made to help eliminate unacceptable approaches. Subsequent analyses of emerging candidate techniques and equipment should be made at several stages of development. EW vulnerability analyses should be performed in accordance with applicable department or agency directives.

4.3.3.3 Developing electronic counter-countermeasures techniques. During each phase of system development and production, available ECCM technology should be reviewed for applicability to EW vulnerability. Where necessary, ECCM capability should be made integral to the system design. It should not be assumed that ECCM remedies can be applied at later stages of system development. EW and ECCM test requirements shall be stated in applicable system specifications. HF radio AJ systems shall comply with applicable provisions of MIL-STD-188-148. VHF radios shall comply with JIEO Specification 9001. UHF radios shall comply with STANAG 4372. Standards for SATCOM AJ systems shall be based on existing UHF, SHF, and EHF common-user DoD satellite systems.

4.3.4 Human engineering design. All information systems, subsystems, and facilities shall be designed in accordance with the applicable requirements of MIL-STD-1472 and MIL-STD-46855, and in accordance with the Human Factor Interface Style Guide (Volume 8 of the TAFIM).

4.3.5 Reliability. All systems and subsystems shall be designed to meet quantitative reliability requirements. The reliability program shall be established in accordance with the applicable requirements of MIL-STD-785. Reliability acceptance tests shall be performed in accordance with the applicable requirements of MIL-STD-781.

4.3.6 Maintainability. All equipment, subsystems, and systems shall be designed to meet quantitative maintainability requirements. The maintainability program shall be established in accordance with the applicable requirements of MIL-HDBK-470. Guidance on the performance of maintainability acceptance tests may be found in MIL-HDBK-471.

4.3.7 Survivability. Survivability is the characteristic of equipment, subsystems, and systems to withstand or avoid such damage mechanisms as blast fragments, bullets, and explosive and incendiary devices, as well as the effects of such natural phenomena as lightning, without causing a malfunction. Survivability can be enhanced by such measures as adding armor plating, duplicating and separating critical components, and simplifying the design to reduce the number of critical components. The survivability of all systems and subsystems should be assessed by performing vulnerability reduction studies in accordance with applicable department or agency directives, regulations, and instructions.

4.3.8 Climatic conditions. All equipment shall be designed to meet the applicable climatic conditions specified in MIL-STD-210. The climatic condition and induced stress requirements for an equipment or an assemblage shall be consistent with the degree of exposure anticipated for intended field applications.

4.3.9 Environmental test methods. All systems and subsystems shall be designed to comply with the applicable environmental test methods specified in MIL-STD-810.

4.3.10 Electrical measurement and test methods. Electrical measurement and test methods for communications systems shall comply with MIL-STD-188-190.

4.3.11 Grounding, bonding, and shielding. Methods and practices for grounding, bonding, and shielding of ground-based telecommunications equipment and facilities, including buildings and structures supporting tactical and long-haul communications, shall comply with the applicable requirements of MIL-STD-188-124. MIL-HDBK-419 provides practical considerations for grounding, bonding, and shielding systems.

4.3.12 Radio regulations. The use of the frequency spectrum is regulated by international agreements embodied in radio regulations published by the General Secretariat of the International Telecommunications Union (ITU), Geneva, Switzerland, and modified periodically by a World Administrative Radio Conference (WARC). These radio regulations are further qualified at the national level through such Federal Government agencies as the Interdepartment Radio Advisory Committee (IRAC), and through such military agencies as the Joint Chiefs of Staff (JCS) and the Military Communications-Electronics Board (MCEB). Military frequency planning, including joint functional frequency allocation tables, is established as a joint action area under the MCEB. For subsystems and equipment design, the choice and performance of the equipment, as well as frequencies and emissions of any radio subsystem, shall satisfy the provisions of those radio regulations. Therefore, radio subsystem designers and users are required to have adequate familiarity with these regulations. Final approval of frequency bands, operating modes, and equipment characteristics within DoD rests with the MCEB.

4.3.13 Radio frequency spectrum characteristics. The spectral characteristics of all radio frequency (rf) transmitters, receivers, and antennas shall be measured in accordance with the applicable requirements of MIL-STD-449.

4.3.14 Conformance testing. ISO 9646 and ITU-T X.290 shall be used for the conformance testing methodology and framework to ensure that conformance testing produces correct and consistent results. DoD Communications Protocol Standards (DCPS) conformance testing shall be in accordance with MIL-HDBK-1350-2. Acquisition agencies are cautioned that successful conformance testing of an equipment will not guarantee interoperability with all other equipment that also passed conformance testing. Conformance testing is not a substitute for interoperability testing.

4.3.15 Interoperability testing. Testing shall be performed to successfully demonstrate that systems successfully interoperate. DCPS interoperability testing shall be in accordance with MIL-HDBK-1350-2. The Joint Interoperability Test Center (JITC) is currently developing an interoperability testing guide. When this document, titled *Open Systems Environment Standards Conformance and Interoperability Testing Methodology*, is published, it will codify the processes for obtaining standards conformance, interoperability certification, or both.

4.3.16 Validation. Validation of data communications protocols (DCP) shall be conducted in accordance with MIL-HDBK-1350-1.

4.4 Subsystem design considerations

4.4.1 Terminal subsystems. Digital interfaces between terminal subsystem equipment shall comply with MIL-STD-188-114 unless other standards apply.

4.4.1.1 Tactical terminal subsystems. Tactical terminal subsystems shall comply with the applicable requirements of MIL-STD-188-216 and MIL-STD-188-260.

4.4.1.2 Long-haul digital terminal subsystems. Long-haul digital terminal subsystems shall comply with the applicable requirements of ANSI standards X3.4, X3.16, and X3.25.

4.4.1.3 Facsimile subsystems. Tactical and long-haul facsimile subsystems shall comply with the applicable requirements of MIL-STD-188-161. STANAG 5000 addresses the protocols that are necessary for facsimile subsystems to work in a noise environment.

4.4.1.4 Tactical digital information links. Message formats and related information for tactical digital information links (TADIL) A, B, and C are published in CJCSM 6231. Technical characteristics for TADILs A and C are published in the MIL-STD-188-203 series; for TADIL B, in MIL-STD-188-212.

4.4.1.4.1 TADIL A subsystems. Technical characteristics of TADIL A subsystems shall comply with applicable requirements of MIL-STD-188-203-1.

4.4.1.4.2 TADIL B subsystems. Technical characteristics of TADIL B subsystems shall comply with applicable requirements of MIL-STD-188-212.

4.4.1.4.3 TADIL C subsystems. Technical characteristics of TADIL C subsystems shall comply with applicable requirements of MIL-STD-188-203-3.

4.4.1.4.4 TADIL J subsystems. Technical characteristics of TADIL J subsystems shall comply with STANAGs 4175 and 5516.

4.4.1.4.5 ATDL-1 subsystems. Technical characteristics of Army Tactical Data Link 1 (ATDL-1) shall comply with CJCSM 6231.

4.4.1.5 Formal record traffic. Until such time that the Defense Message System replaces the legacy Formal Record Traffic system, the interoperability standards described in 4.4.1.5.1 to 4.4.1.5.4 shall apply.

4.4.1.5.1 Mode I. MIL-STD-188-171 will provide the Mode I channel coordination procedure for synchronous, simultaneous, duplex data transfer over terrestrial links.

4.4.1.5.2 Mode II. MIL-STD-188-172 will provide the Mode II non-ARQ channel coordination procedure for asynchronous, simultaneous, independent, duplex data transfer.

4.4.1.5.3 Mode V. MIL-STD-188-173 will provide the Mode V ARQ channel coordination procedure for asynchronous, simultaneous, independent, duplex data transfer.

4.4.1.5.4 Mode VI. MIL-STD-188-174 will provide the Mode VI ARQ channel coordination procedure for synchronous, simultaneous, duplex data transfer.

4.4.2 Transmission subsystems. Transmission subsystems include fiber optic cables, metallic lines, and satellite and terrestrial radios.

4.4.2.1 Long-haul transmission subsystems. Long-haul transmission subsystems shall comply with the performance requirements given in 5.7.

4.4.2.2 Tactical transmission subsystems. Tactical transmission subsystems shall comply with the applicable requirements of MIL-STD-188-202.

4.4.2.3 Fiber optic communications subsystems. Long-haul fiber optic subsystems shall comply with the applicable requirements of MIL-

STD-188-111. Tactical fiber optic subsystems shall comply with the applicable requirements of MIL-STD-188-111 and JIEO Specification 9109.

4.4.2.4 Metallic line transmission subsystems. Wire and cable transmission subsystems shall comply with the applicable requirements of MIL-STD-188-112.

4.4.2.5 Frequency-division multiplex subsystems. Frequency- division multiplex subsystems shall comply with the applicable requirements of MIL-STD-188-311.

4.4.2.6 Radio subsystems operating in medium frequency and lower bands. Radio subsystems operating in the medium frequency (MF) band shall comply with the applicable requirements of MIL-STD-188-141. Radio subsystems operating in the low frequency (LF) and lower bands shall comply with the applicable requirements of MIL-STD-188-140.

4.4.2.7 High frequency radio subsystems. Radio subsystems using frequencies between 3 and 30 MHz shall comply with the applicable requirements of MIL-STD-188-141. AJ transmission systems operating in the HF band shall comply with the applicable requirements of MIL-STD-188-148 and MIL-STD-188-110. HF digital voice shall use LPC at 2.4 kbps, in accordance with MIL-STD-188-113. Automatic link establishment (ALE) of HF radio links shall be accomplished using the waveforms and procedures specified in Appendix A of MIL-STD-188-141.

4.4.2.8 Very high frequency radio subsystems. Radio subsystems using frequencies between 30 and 300 MHz shall comply with the applicable requirements of MIL-STD-188-242.

4.4.2.9 Ultra high frequency radio subsystems. Radio subsystems using frequencies between 300 and 3000 MHz shall comply with the applicable requirements of MIL-STD-188-243.

4.4.2.10 Super high frequency radio subsystems. Radio subsystems using frequencies between 3 and 30 GHz shall comply with the applicable requirements of MIL-STD-188-145.

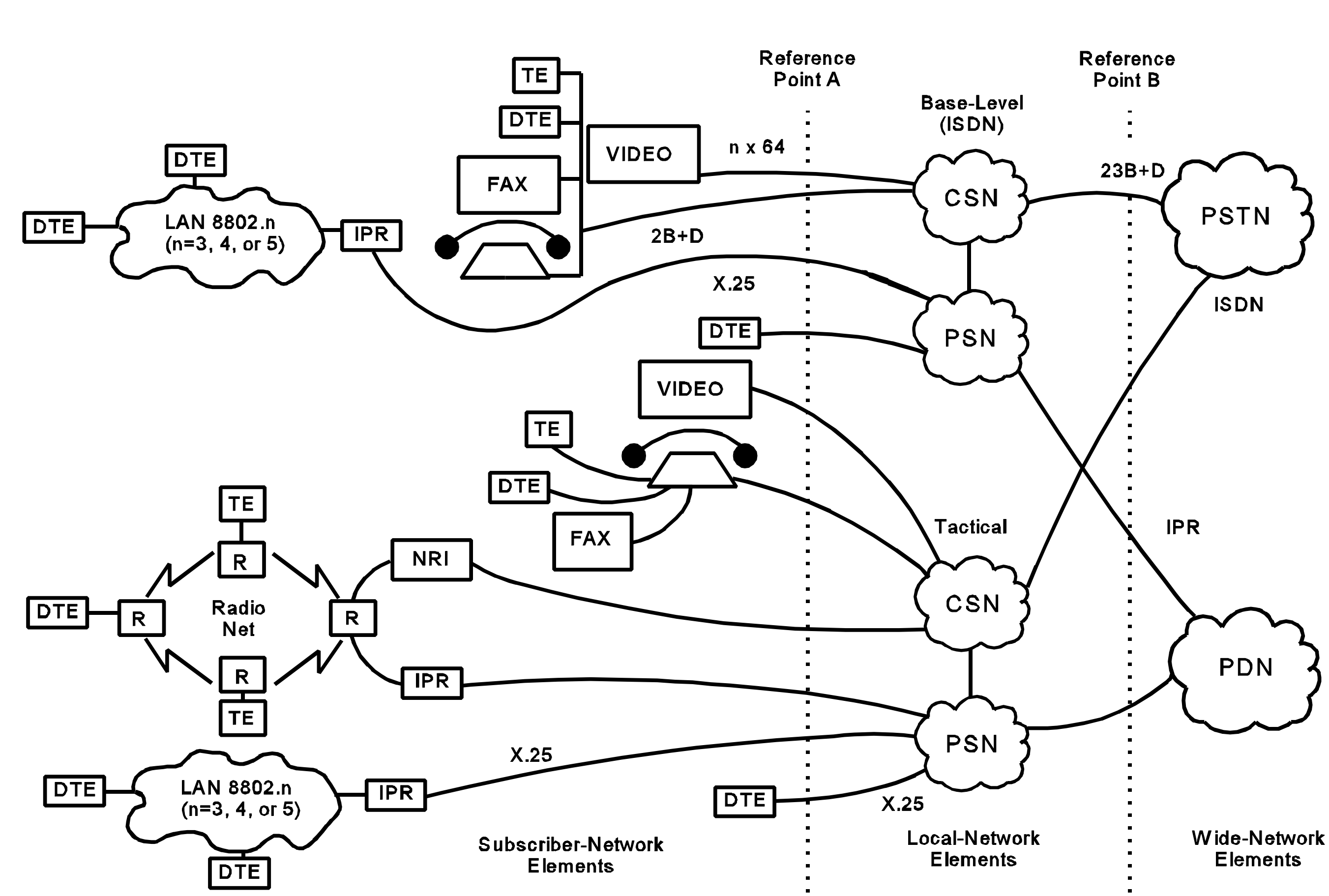
4.4.2.11 Extremely high frequency radio subsystems. Technical characteristics of EHF radio subsystems (30-300 GHz) are under consideration.

4.4.2.12 Single-channel-radio to switched-system interfaces. See 5.1.1.3.

4.5 Functional interface requirements. This section defines the scenario, network elements, and applications supported by this MIL-STD. This scenario and these applications determine which standards, options, and parameters are incorporated in this MIL-STD.

4.5.1 Scenario. The development of new systems is driven by the availability of new technology and funding for implementation. DoD procures nondevelopmental items (NDI) to meet military requirements at reduced costs. DoD will take advantage of rapid advances in commercial computer and communications technology, as well as emerging open standards, to meet future command, control, communications, and intelligence (C3I) requirements. Military-unique features must be introduced early in the commercial standards development cycle. Higher-performance processing systems and the provision of intelligent networks are new trends that will affect the DISN. These changes will accompany the introduction of ISDN for base and long-haul requirements, whereas the tactical system has evolved to an all-digital system based on MIL-STD-188-256. The tactical environment is expected to further evolve toward a commercial standard, as the Services upgrade their deployable systems. In the future, broadband-ISDN (B-ISDN) services will become part of the DISN. Broadband services will provide interactive and distribution services. Interactive services include bidirectional communications with real-time information transfer, such as conferencing, between users. Distribution services include broadcast services such as television or audio programs. The starting time of distributive services may or may not be controlled by the user. Tactical assets may have limited capability for broadband services, due to spectrum limitations. In the long term, ATM transport will be extended as far into the deployed environment as practical. Further extensions of services into the deployed area will be via wireless communications.

4.5.2 Network elements. This MIL-STD identifies the standards necessary for information exchange between subscribers of common-user switched systems. Subscribers may be connected to the same network, or they may be connected to different but interconnected networks. Each network may consist of different elements, as illustrated in Figures 5 and 6. Figure 6 describes the DISN Goal



Legend:

CSN	-	circuit-switched network	PSTN	-	public switched telephone network
DTE	-	digital terminal equipment	R	-	radio
IPR	-	IP router	TE	-	terminal equipment
PDN	-	public data network	23B + D	-	primary rate interface
PSN	-	packet-switched network			

FIGURE 5. Typical DII network elements (ATM not shown).

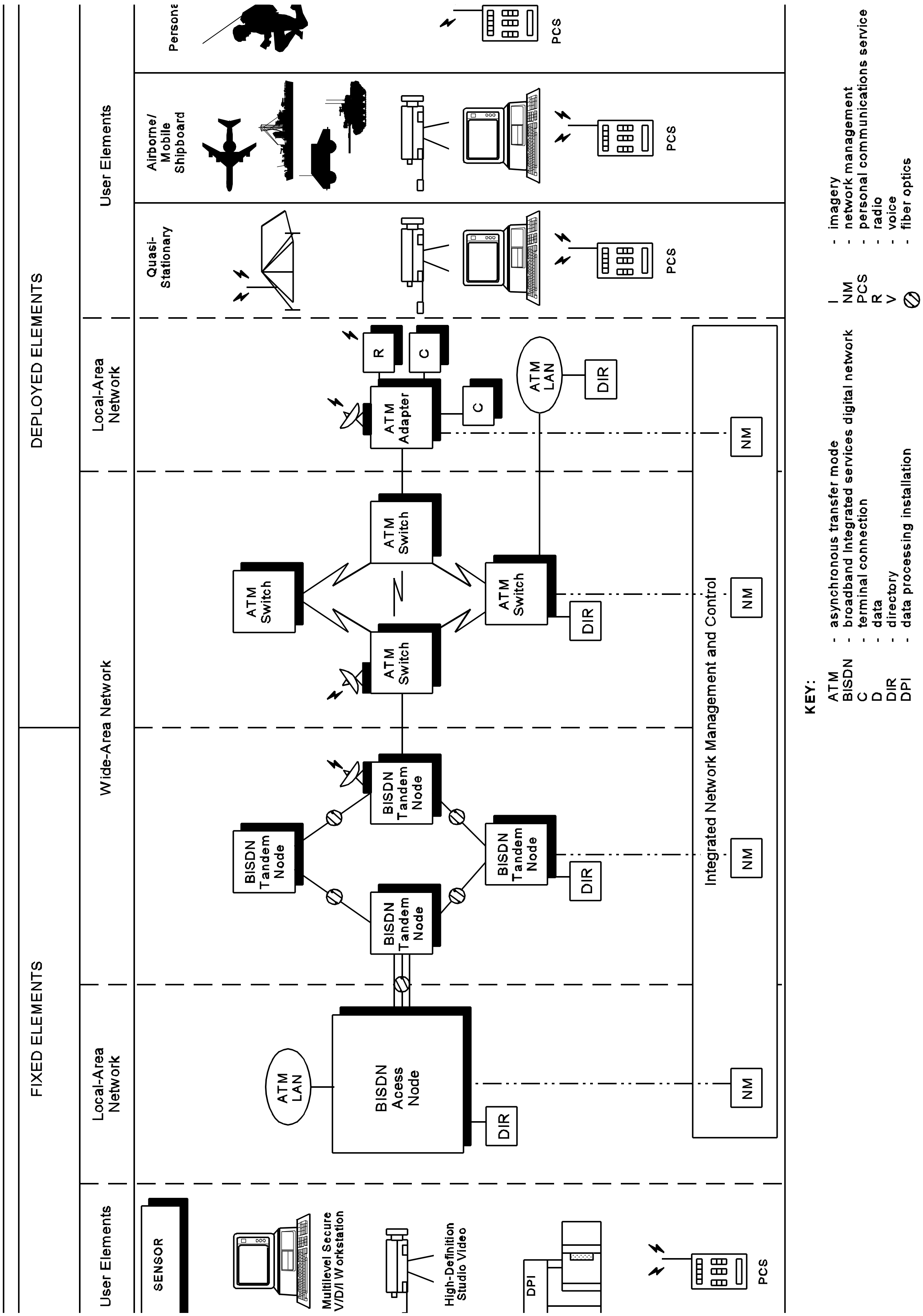


FIGURE 6. Key elements of the DISN Goal Architecture.

Architecture. These network elements are described in 4.5.2.1 to 4.5.2.4. (See the DISN Architecture.)

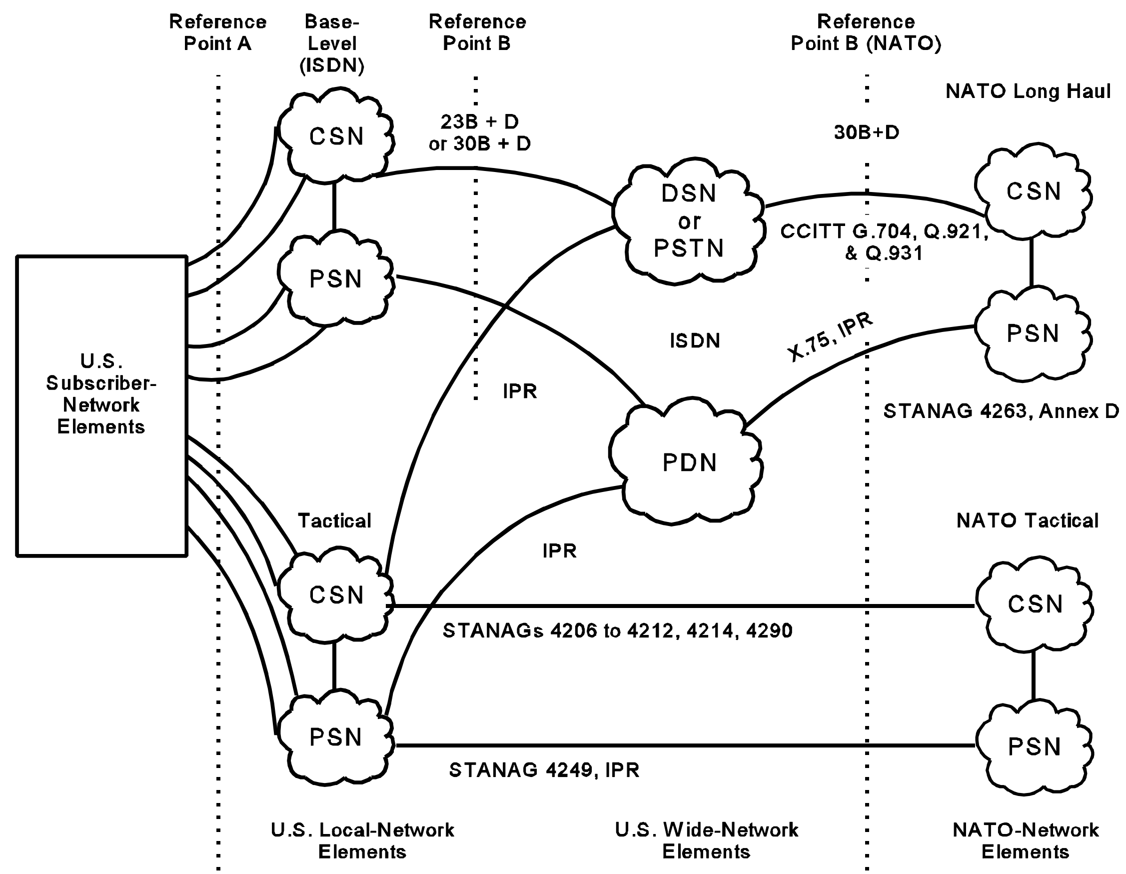
4.5.2.1 Subscriber-network elements. Two types of subscriber- network elements exist: subscriber terminal equipment and subscriber networks. Subscriber terminal equipment, which can be manned or unmanned, includes telephones; teleprinters; facsimile machines; data terminals (such as host computers, workstations, personal computers, digital-message entry devices, sensors, and weapons systems); video terminals; or other information sources and sinks. Subscriber networks, through a common media, provide connectivity between a limited set of subscribers. These networks can provide selective addressing, but they do not switch or route traffic. Subscriber networks may be local area networks (LAN), as defined in International Organization for Standardization (ISO) 8802-3, 8802-4, and 8802-5; or radio networks such as combat radio networks. The data communications protocols that support digital message transfer devices (DMTD) and C4I system interoperability over combat net radio are specified in MIL-STD-188-220. Subscriber terminal equipment and subscriber networks are illustrated in Figure 5. Terminal equipment (TE) designates equipment used to exchange either voice or non-voice information. DTE represents data terminals used for information-transfer applications. IPR represents routers used to transfer data between different subnetworks. *R* represents a radio terminal in a network of similar radios, for example, the Position Location Reporting System (PLRS), the Joint Tactical Information Distribution System (JTIDS), or combat net radio (CNR). For broadband systems, as illustrated by the DISN Goal Architecture of Figure 6, subscriber elements include sensors, multilevel secure voice/data/imagery workstations, high-definition studio video, data-processing installations, and personal communications services (PCS). Not shown in Figure 6 for deployed systems are the subscriber radio networks, as well as the LANs, which may be indigenous to the deployed platforms (aircraft, ships, trucks, and tanks). Subscriber terminal equipment and subscriber networks shall be directly connected to the local-network elements by cable (metallic or fiber) or by multi-role radio. The interface between subscriber-network elements and local-network elements is identified as reference point A.

4.5.2.2 Local-network elements. Local-network elements are the circuit switches, packet switches, and transmission equipment that constitute the common-user systems provided by the military Services. They provide switched service for base-level and tactical users. Local-network elements are illustrated in Figure 5. The base-level circuit-switched networks (CSN) and packet-switched networks (PSN) are based on commercial standards for ISDN. Tactical CSNs and PSNs currently interface with TRI-TAC equipment; future upgrades to tactical systems should be based on commercial standards. Compatible terminal equipment shall be able to exchange information via switched networks comprised of local-network elements. The interface between subscriber-network elements and local-network elements shall comply with the standards described in 5.1. Tactical CSNs and PSNs within a theater of operations may be interconnected without going through the Defense Information Switched Network (DISN). As illustrated in the DISN Goal Architecture of Figure 6, local-network elements include ATM adapters, as well as broadband and digital hierarchy transmission equipment, ATM LANs, and (not shown) FDDI subnetworks. The interface between local-network elements and wide-network elements is identified as reference point B. Broadband local-network elements are based on the commercial standards identified in 5.4.

4.5.2.3 Wide-network elements. Wide-network elements are the circuit switches, packet switches, and transmission equipment provided by the Defense Communications System (DCS) and public switched telephone networks (PSTN). Wide-network elements are used to transfer information between remote local-network elements. The interface between local-network elements and wide-network elements shall comply with the standards described in 5.1.2. As illustrated by the DISN Goal Architecture of Figure 6, wide-network elements include ATM switches, broadband, and digital hierarchy transmission equipment. Broadband transmission bit-rates used in fixed networks will be based on the synchronous optical network (SONET) (see Table VIII in 5.4.1.2.1). For deployed LOS radios, bit rates will be reduced to 1.544 Mbps (DS1) to match current LOS bandwidth constraints. In the future, LOS bandwidths should include DS3. The interfaces between local-network elements and wide-network elements shall comply with the commercial standards described in 5.4.

4.5.2.4 NATO-network elements. North Atlantic Treaty Organization (NATO) network elements are the circuit switches, packet switches, and transmission equipment provided by NATO nations or those portions of the DCS that adhere to the technical standards of the host nation. Subscribers to U.S. common-user systems shall be able to exchange information with subscribers of other nations through reference point B (NATO), as illustrated in Figure 7. The interface between U.S. network elements and NATO network elements shall comply with the STANAGs and ITU-T standards described in 5.1.3. Future network elements shall comply with the Project Group (PG/6) *Tactical Communications Post-2000 Architecture*, which will lead to development of STANAGs in its final phase.

4.5.3 Military enhancements to commercial data communications protocols and standards. The intent of this MIL-STD is to adopt commercial standards for military use whenever it meets Government requirements. In some cases the commercial standards are not acceptable; thus, they require enhancements to satisfy the complete military requirement for a specific function or



Legend:

CSN	- circuit-switched network	PSN	- packet-switched network
IPR	- IP router	PSTN	- public switched telephone network
ISDN	- integrated services digital network	STANAG	- standardization agreement
NATO	- North Atlantic Treaty Organization	23B + D	- primary rate interface
PDN	- packet data network	30B + D	- European primary rate interface

FIGURE 7. Typical DII interface with NATO network elements.

capability. These enhancements shall be found in the MIL-STD-2045 series. Eight military features have been identified in the data communications protocol area that are not adequately addressed by existing commercial data communications standards. These features are described in 4.5.3.1 through 4.5.3.8. Acquisition authorities should review the standards to ensure that these features are satisfactorily addressed and supplement their procurement documentation, as necessary.

4.5.3.1 Multihomed and mobile host systems. Multihoming is a mechanism for attaching an end system to two or more network access points so that a system setting up a call to the end system is not aware of the extra connectivity. In addition to enhancing survivability, this mechanism may be extended to "mobile hosts" such as aircraft, ships, and land vehicles during the move from one node to another.

4.5.3.2 Multi-endpoint connections (multi-addressing). To transmit data to a number of recipients (a common occurrence in signal handling), a user must establish a connection for each recipient and send a separate copy of the data across each connection. More efficient use is made of the communications resources (in particular, improved performance in terms of minimizing delay and conservation of bandwidth) if the sender has to transmit only one copy of the data. The network then takes care of routing, controlling, and distributing the data.

4.5.3.3 Internetworking. Mechanisms are required to facilitate the interconnection of various systems at the boundary point between subnetworks. Many of the interconnections would be engineered during interoperability testing.

4.5.3.4 Network and system management. Management functions are required that may be more sophisticated than those considered satisfactory for civilian networks: (a) management of broken networks, in which layers of protocols are inoperable; (b) fast responses to changes in network topology, which are essential to maintain important connections; and (c) counterattack management, to recognize and counter the effects of intelligent attack on and physical damage to the network.

4.5.3.5 Security. Protection measures are required (a) to prevent unauthorized access to the system and ensure the confidentiality of the information it carries, and (b) to preserve the integrity of the data and mitigate against denial of service.

4.5.3.6 Quality-of-service. The range of quality-of-service parameters required for military systems exceeds those currently permitted within civilian networks. The particular aim, to maximize network survivability, is to maintain an adequate quality-of-service to the users (or at least to users operating above a given priority level) in the face of a severely damaged or partitioned network. A military requirement exists for an ultimate delivery capability, whereby important communications are sustained, even at very low data rates.

4.5.3.7 Precedence and preemption. To minimize congestion, particularly in a damaged network where resources are at a premium, it is desirable to be able to allocate resources on the basis of priority levels assigned to the messages being routed through the congested area. A facility is therefore required to associate a priority level with a message. This requirement is needed for both connection-oriented and connectionless communications.

4.5.3.8 Real-time and tactical communications. Certain applications (often tactical in nature) require communications with specified time outs, which can be in the range of milliseconds to seconds. Accurate sequencing is essential.
Real time may also include high demands on sequencing accuracy.

4.5.4 Enhancements for tactical environments. DoD requires use of commercial data communications protocol standards wherever possible. Most commercial data communications standards rely on "ACK/NACK" protocols for error detection and correction. This is fine for the error environment found in commercial and strategic communications networks. However, tactical communications environments are more severe than their commercial counterparts, and reliance on ACK/NACK protocols will likely result in extremely low throughput. In some cases channel quality can be improved by operational changes such as (a) increased transmitter power; (b) better antenna setting, alignment, or both; or (c) decreased transmission rate. Beyond these link engineering activities, forward error correction (FEC) codes should be used to reduce the link bit error ratio (BER). FEC techniques applied at the physical layer will provide a higher-quality service to the higher layers and yet maintain the higher-layer protocol necessary to be interoperable with strategic networks. For tactical systems working across the NATO digital interface, FEC should comply with Class 4, as defined in STANAG 4213. The appropriate standardized FEC techniques for other tactical interfaces need further study.

4.5.5 Functional profiles. To promote open digital systems, the commercial world has developed the 7-layer Open Systems Interconnection (OSI) reference model (RM), ISO 7498, with corresponding ISO and ITU-T standards. ANSI standards address the differences between North American and European implementations. The National Institute of Standards and Technology (NIST) developed the Government Open Systems Interconnection Profile (GOSIP), Federal Information Processing Standard (FIPS) PUB 146, which specified a subset of existing standards approved for Government use. GOSIP has evolved into the Profiles for Open Systems Internetworking Technologies (POSIT), FIPS PUB 146-2, which encourages the use of voluntary open standards, including the Internet Protocol Suite (IPS) standards disseminated by the Internet Architecture Board (IAB). (FIPS-PUB-146-1 was originally used to develop this MIL-STD.) To define the end-system interface for data communications, the 7-layer OSI RM is divided into two profiles. The top 3 layers are designated the *application profile*, and the remaining lower 4 layers are designated the *transport profile*. The application and transport profiles are described in 5.2. The *relay profile* represents the interface between two different systems and consists of the lower 3 layers with a relay function that maps one system's network layer into the other system's network layer. Relay profiles occur at Reference points A and B and are described in 5.1.1 and 5.1.2, respectively.

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5. DETAILED REQUIREMENTS

5.1 Reference point standards

5.1.1 Standards for reference point A. This section defines the standards applicable at the interface between the subscriber terminal equipment (or the subscriber's network equipment) and the local-network element (reference point A). See Figure 5.

5.1.1.1 ISDN-terminal to base information-transfer system. The terminal equipment interfacing with the base information-transfer system shall comply with the existing ANSI standards and ITU-T Recommendations cited in 5.1.1.1.1 to 5.1.1.1.3.3, and shall conform to FIPS-PUB-146 for ISDN basic rate access at the user-to-network interface. This interface applies to both circuit-switched and packet-switched service.

5.1.1.1.1 Layer 1 (the physical layer). Layer 1 provides the mechanical, electrical, functional, and procedural characteristics to activate, maintain, and deactivate a physical circuit. Layer 1 allows for the transparent transmission of bits between the terminal equipment and local-network elements. The interface between the terminal equipment and local-network elements shall comply with ANSI T1.601. This interface shall support up to 2 full-duplex, 64-kbps information bearer channels; 1 full-duplex, 16-kbps signaling channel; and 1 full-duplex,
16-kbps overhead channel over a single twisted pair of telephone wires.

5.1.1.1.1.1 Physical characteristics. The wiring polarity and connector shall comply with ANSI T1.601, the section titled *Physical Characteristics*.

5.1.1.1.1.2 Transmission method. The line code used on the twisted pair of telephone wires shall be 2B1Q (2 binary, 1 quaternary), as defined in ANSI T1.601, the section titled *Transmission Method*.

5.1.1.1.1.3 Functional characteristics. The modulation rate of the 2B1Q signal shall be 80 kilobaud. The timing signal for the subscriber's terminal equipment shall be slaved to the signal received from the local-network element. The two 64-kbps bearer channels, the 16-kbps signaling channel, and the 16-kbps overhead channel shall be multiplexed in accordance with the frame structure defined in ANSI T1.601, the section titled *Functional Characteristics*.

5.1.1.1.1.4 Electrical characteristics. The subscriber's terminal equipment shall comply with the impedance and return loss, longitudinal output voltage, longitudinal balance, jitter, and dc characteristics defined in ANSI T1.601, the section titled *Electrical Characteristics*.

5.1.1.1.2 Layer 2 (the data link layer). Layer 2 defines the procedures required to establish, maintain, and disconnect the data link between the subscriber's terminal equipment and the network.

5.1.1.1.2.1 Signaling channel (the D-channel). The link access procedure on the D-channel shall comply with ANSI T1.602. T1.602 contains the complete text of ITU-T Q.920 and Q.921, which specify the frame structure, the procedure elements, the field formats, and the link access procedures (LAP) for the D-channel (LAPD). Out-of-band signaling procedures (D-channel) shall be used to negotiate a packet-switched or circuit-switched connection for each information bearer channel.

5.1.1.1.2.2 Signaling in the bearer channel. Packet-switched calls shall be connected to the local packet handler. Remaining signaling information, including the called user address, shall be provided in the bearer channel and shall comply with the link access procedures balanced (LAPB), as defined in sections 2.2, 2.3, and 2.4 of ITU-T X.25 for basic (modulo 8) operation. Connections for circuit-switched calls shall be completed based on D-channel signaling only. At the user-to-network interface, layer 2 does not apply to information bearer channels, for circuit-switched calls.

5.1.1.1.3 Layer 3 (the network layer). Layer 3 protocols provide the information required to route calls through the local- and wide-network elements to the destination-terminal equipment. Three types of signaling messages shall be used to control circuit-switched and packet-switched connections: call establishment, call clearing, and miscellaneous messages. A list of the messages in each category is provided in Tables I and II.

TABLE I. Messages for circuit-switched connection control.

CALL ESTABLISHMENT	CALL CLEARING	MISCELLANEOUS
Alerting	Disconnect	Information
Call Proceeding	Release	Notify
Connect	Release Complete	Status
Connect Acknowledge	Restart	Status Inquiry
Progress	Restart Acknowledge	
Set-up		
Set-up Acknowledge		

TABLE II. Messages for packet-switched connection control.

CALL ESTABLISHMENT	CALL CLEARING	MISCELLANEOUS
Alerting	Disconnect	Status
Call Proceeding	Release	Status Inquiry
Connect	Release Complete	
Connect Acknowledge	Restart	
Progress	Restart Acknowledge	
Set-up		

5.1.1.1.3.1 Circuit-switched connections. The definition, message format, and information element coding for messages used to control circuit-switched connections shall be as defined in ITU-T Q.931. It specifies the messages and procedures used for control of circuit-switched connections at user-to-network interfaces. The messages are exchanged over the D-channel and apply to both basic-rate and primary-rate interfaces.

5.1.1.1.3.2 DSN features. The circuit-switched call control procedures described in ITU-T Q.931 shall be used in the control of supplementary procedures, as specified in ANSI T1.610, except where modified to provide for DSN features. The following DSN features shall be implemented in accordance with the mandatory Appendix A titled *DSN No. 7 Common Channel Signaling*:

a. Multi-level precedence and preemption (MLPP)

b. Off-hook (or hot-line) service

c. Preset conference calling

5.1.1.1.3.3 Packet-switched connections. The definition, message format, and information element coding for messages used to control packet-switched connections are defined in ANSI T1.608. ANSI T1.608 specifies the messages and procedures used for control of packet-switched connections at user-to-network interfaces. The procedures in T1.608 shall be used for the following two cases:

Case A: Circuit-switched access to packet-switched public data network. Layer 3 signaling between the subscriber's terminal equipment and the public data network (PDN) shall comply with the packet level protocol defined in section 3 of ITU-T X.25. Only the B-channel is used after the circuit-switched connection to the PDN is completed. Signaling for the circuit-switched portion of the call shall be accomplished using the D-channel.

Case B: <u>Packet-switched access to an ISDN virtual circuit service (B- and D-channels)</u>. Layer 3 signaling between the subscriber and the ISDN packet handler shall comply with the packet layer protocol defined in section 3 of ITU-T X.25. The connection between the subscriber's terminal equipment and the packet handler may be a full period connection or may be obtained using D-channel signaling, as defined in ANSI T1.608. In this case, the information bearer channel may be either a B- or D-channel.

A list of the ANSI T1.608 messages applicable to D-channel signaling is provided in Table I for Case A and Table II for Case B.

5.1.1.1.3.4 <u>Circuit-switched access to IP router network</u>. Signaling for the circuit-switched portion of the call shall be accomplished using the D-channel. Only the B-channel is used after the circuit-switched connection to the PDN is completed. Layer 3 signaling in the B-channel between the subscriber's terminal equipment and the IP router network shall comply with MIL-STD-2045-14502-1.

5.1.1.2 <u>Terminal-equipment to tactical-network interface</u>. The terminal equipment interface for tactical users shall comply with the existing MIL-STD-188 series standards and ITU-T Recommendations cited in 5.1.1.2.1 and 5.1.1.2.2.

5.1.1.2.1 <u>Tactical circuit-switched connections</u>. The terminal equipment interface for tactical circuit-switched users shall comply with 5.1.1.2.1.1 to 5.1.1.2.1.3.

5.1.1.2.1.1 <u>Layer 1 (the physical layer)</u>. Loops between tactical terminal equipment and tactical local-network elements shall operate on a full-duplex, 4-wire basis with a transmit pair and a receive pair. Common battery may be provided between the pairs by a local-network element. The loop shall operate at a 16-kbps information rate in each direction, using conditioned diphase, as defined in MIL-STD-188-200. The signal amplitude shall be 3 V, plus or minus 10 percent, with a source impedance of 125 ohms, resistive.

5.1.1.2.1.2 <u>Layer 2 (the data link layer)</u>. Tactical loop signaling shall be in-band, using 8-bit cyclically permutable codewords. The codewords shall be repeated continuously until acknowledged or timed-out, in accordance with MIL-STD-188-256. The idle state, for the signaling channel, shall consist of alternating ones and zeros.

5.1.1.2.1.3 Layer 3 (the network layer). Tactical loop signaling shall be in accordance with MIL-STD-188-256, the section titled *Digital loop signaling and supervision*. Certain codewords shall be used to represent more than one signaling statement. The ambiguity shall be resolved by considering the context of the signaling sequence involving use of the codewords.

5.1.1.2.2 Tactical packet-switched connections. As illustrated in Figure 5, a host computer or DTE may be connected to a tactical packet switch in three ways:

a. By direct cable connection to a packet switch.

b. By connection to a LAN through an IP router (IPR) to a packet switch (the IPR may be located with the LAN or with the packet switch).

c. By connection through a circuit switch to a packet switch (in this case, the host computer or DTE must first call up the local packet switch).

5.1.1.2.2.1 Layer 1. The interface, at reference point A, shall comply with MIL-STD-188-114 for 5.1.1.2.2 a and b. It shall comply with 5.1.1.2.1.1 for 5.1.1.2.2 c.

5.1.1.2.2.2 Layer 2. The protocol used to access the packet switch shall comply with LAPB basic (modulo 8) operation, as defined in sections 2.2, 2.3, and 2.4 of ITU-T X.25. The X.25 packet-switched network shall conform to the Internet Transport profile for DoD communications, as specified in MIL-STD-2045-14502-3.

5.1.1.2.2.3 Layer 3. Layer 3 signaling between the subscriber's terminal equipment and the IPR network shall comply with MIL-STD-2045-14502-1. Signaling between the IPR and the packet switch shall comply with the packet layer protocols defined in section 3 of ITU-T X.25.

5.1.1.3 Net-radio-terminal to tactical-network interface. Tactical network elements shall provide circuit-switched and packet-switched service to and from radio networks. Interoperability between the radio network and local-network elements shall be achieved by providing a net radio interface (NRI) for circuit-switched voice and data calls, or an IPR for packet-switched data communications. To support data operations, CNR shall conform to the Internet Transport profile for DoD communications, as specified in MIL-STD-2045-14502-6, which profiles MIL-STD-188-220.

5.1.1.3.1 Circuit-switched connections. Tactical circuit-switched network interfaces to net radio terminals shall use the same loop signaling protocols as described in 5.1.1.2.1.3, with the addition of a means to control the NRI gateway's push-to-talk function. These means may be manual (whereby a local operator monitors both sides of the interface) or automatic. Automatic operation may be achieved by voice-operated transmit (VOX), digitized push-to-talk control tone bursts (1231 Hz, transmit on; 1455 Hz, transmit off), dual-tone multifrequency (DTMF) digits (1 transmit on, 3 transmit off), or digital start-of-transmission/end-of-transmission codewords.

5.1.1.3.2 Packet-switched data. Tactical packet-switched network interfaces to and from net radio terminals shall use the same protocols described in 5.1.1.2.2. The IPR may be an integral part of the radio terminal located at the network gateway.

5.1.2 Standards for reference point B. This section defines the standards applicable at the interface between local-network elements and wide-network elements.

5.1.2.1 ISDN base-level interface to reference point B. Base information-transfer systems shall comply with 5.1.2.1.1 to 5.1.2.1.3 at reference point B.

5.1.2.1.1 Layer 1. The signal at the wide-network interface shall comply with the following parameters, as specified in ANSI T1.408, for the primary rate interface (PRI):

a.	Line code	Bipolar with 8-zero substitution (B8ZS) and 50% duty cycle.
b.	B8ZS	Eight consecutive zeros shall be replaced with 000+-0-+ if the preceding pulse was positive and with 000-+0+- if the preceding pulse was negative.
c.	Bit rate	1.544 Mbps.
d.	Number of channels	24 (Normally 23 channels are used as information-bearer channels and 1 channel is reserved for common-channel signaling.)
e.	Frame format	193-bit frame (see Figure 8).

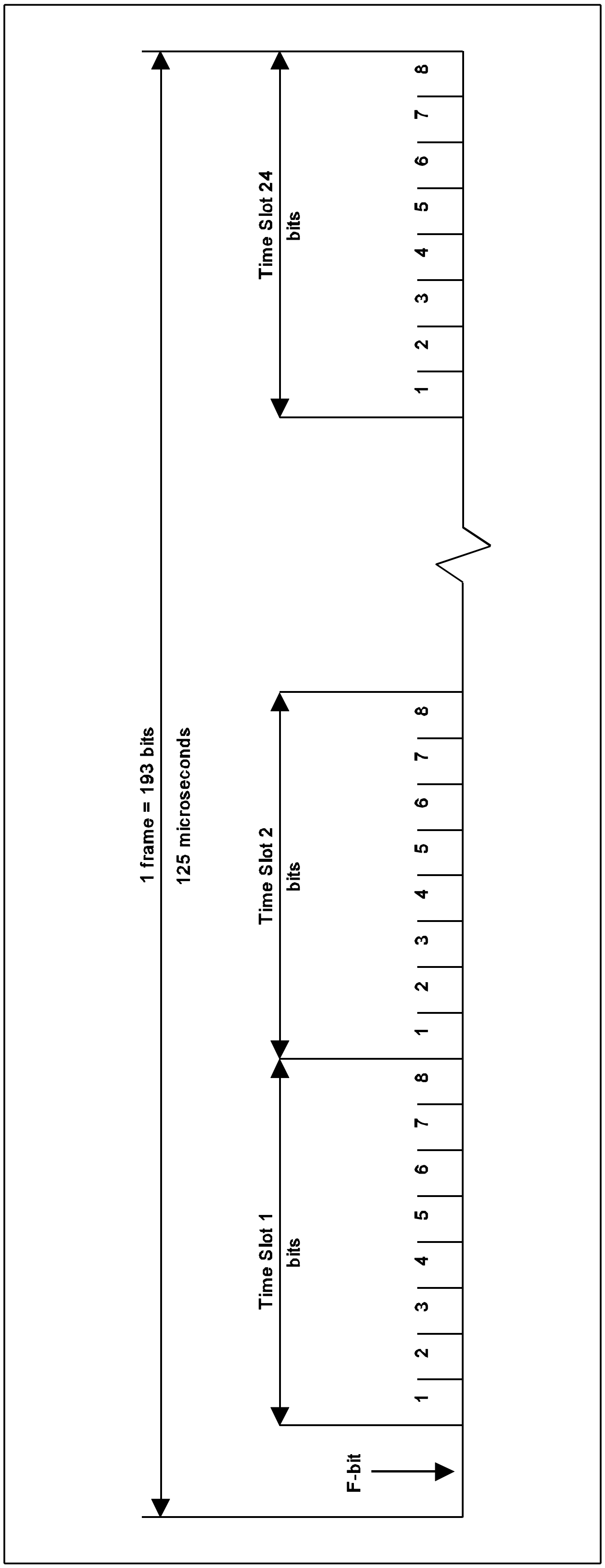


FIGURE 8. Frame format for a 1.544-Mbps signal.

f.	Frame repetition rate	8000 frames per second.
g.	F-bit signal bit rate and allocation	2000 bps of the 8000-bps F-bit signal shall be used for the frame alignment signal (FAS). To convey fault status and maintenance information, 4000 bps shall be available for use as a data link (data orderwire). Using the CRC-6 cyclic redundancy check as defined in ANSI T1.408, 2000 bps shall be available for performance monitoring.
h.	F-bit signal format	See Table III.
i.	High rate signals	H_0=384 kbps; H_{10}=1472 kbps; H_{11}=1536 kbps. (H_{10} and H_{11} are optional services.)
j.	Time-slot assignment	Time slot 24 shall be used to transfer common-channel signaling information (D-channel), when it is present. A channel shall occupy an integer number of time slots and the same time-slot positions in every frame. A B-channel may be assigned any time slot in the frame; an H_0-channel shall be assigned any six slots in the frame, in numerical order (not necessarily consecutive); and an H_{10} channel shall be assigned time slots 1 to 23. The assignment may vary on a call-by-call basis.
k.	Signaling data link	The signaling data link bit rate shall be 56 kbps, evolving to 64 kbps. Fifty-six kbps signals shall occupy bit positions 1, 2, 3, . . ., 7 of the 64-kbps D-channel.

TABLE III. F-bit signal format.

FRAME NUMBER	F-BITS			
	BIT NUMBER	**FAS**	**DL**	**CRC**
1	1		m	
2	194			C1
3	387		m	
4	580	0		
5	773		m	
6	966			C2
7	1159		m	
8	1352	0		
9	1545		m	
10	1738			C3
11	1931		m	
12	2124	1		
13	2317		m	
14	2510			C4
15	2703		m	
16	2896	0		
17	3089		m	
18	3282			C5
19	3475		m	
20	3668	1		
21	3861		m	
22	4054			C6
23	4247		m	
24	4440	1		

Notes:
FAS = framing alignment signal
DL = 4-kbps data link
CRC = CRC-6 cyclic redundancy check
m = data bit in maintenance channel

The unused bit position shall be set to "1." The signaling data link shall be a bidirectional transmission path for common-channel signaling, comprising two "data channels" operating together in opposite directions at the same data rate. The signaling data link constitutes the lowest functional level (layer 1) in the SS7 functional hierarchy. SS7 shall be capable of operating over both terrestrial and satellite transmission links. The operational signaling data link shall be exclusively dedicated to the use of a SS7 signaling link between two signaling points in SS7.

5.1.2.1.2 Layer 2. The data link layer shall provide for reliable transfer of common-channel signaling information across the physical channel. This shall include error control, message sequencing, and message delimitation. Data link signaling functions and procedures shall comply with ANSI T1.111, the section titled *Signaling data link*. The data link layer shall also be responsible for initializing the link and logically disconnecting secondary stations.

5.1.2.1.3 Layer 3. The network layer shall comply with the following requirements.

a. Layer 3 protocols shall comply with ANSI standards T1.111 (sections 4 and 5), T1.112, T1.113, and T1.114.

b. The interworking relationship between the D-channel signal at the user-to-network interface and the ISDN-User Part, as defined in ANSI T1.113, shall comply with ANSI T1.609.

5.1.2.2 Tactical-network interface to reference point B. Tactical local-network elements are likely to change in the long-range future to reflect commercial 64-kbps ISDN architectures for fixed applications and 4.8-kbps architectures for mobile applications. Future tactical interfaces are likely to reflect these commercial standards when they are in place. The near-term standards for tactical local-network elements shall comply with MIL-STD-188-105, the section titled *Tactical network interface to reference point B*.

5.1.2.3 Wide-network interface to reference point B. This interface is the same as the ISDN base-level interface (see 5.1.2.1).

5.1.2.4 Gateway functions. The tactical, ISDN base-level, and wide networks shall provide end-user to end-user service. The gateway function at reference point B shall provide signal conversion, as described in MIL-STD-188-105, to obtain interoperability between strategic and tactical users.

5.1.2.4.1 Circuit-switch-signaling message conversion. Interoperability between tactical circuit switches and ISDN circuit switches shall be accomplished through appropriate transformation of signaling messages at the gateway function located at reference point B. The gateway function shall translate out-of-band signaling messages between the tactical circuit-switched network and ISDN switched networks for calls initiated in either direction, in accordance with MIL-STD-188-105.

5.1.2.4.2 Packet switching. Tactical packet switches and ISDN packet switches shall comply with ITU-T X.75 for connection mode service. They shall provide interoperability between host computers connected to tactical packet-switched networks and host computers connected to ISDN packet-switched networks. IP shall be used for connectionless mode service between tactical packet-switched networks and ISDN packet-switched networks.

5.1.2.4.3 Voice telephony. Tactical telephone subscribers shall be interoperable with ISDN telephone subscribers. Normally, this shall be accomplished by conversion between the tactical voice algorithm and the ISDN voice algorithm. See 4.1.6.1 for a description of ISDN and tactical voice algorithms. The gateway function shall provide the capability to achieve end-to-end secure voice calls by providing a transparent, bit-rate-adapted connection between compatible digital voice terminals, as described in 4.1.6.1, and MIL-STD-188-105.

5.1.2.4.4 Circuit-switched data. The gateway function shall provide for the transfer of circuit-switched data between tactical users and ISDN users. The gateway function shall provide bit-rate adaptation for ISDN B-channels in the manner described in 4.1.6.1.4, for standard bit rates up to 16 kbps.

5.1.3 Standards for reference point B (NATO). This MIL-STD defines the standards applicable to the interface between U.S. network elements and NATO network elements.

5.1.3.1 U.S.-wide-network to NATO interface. The interface between U.S. strategic and NATO strategic circuit-switched networks shall comply with 5.1.3.1.1 to 5.1.3.1.3. The interface between U.S. strategic and NATO strategic packet-switched networks shall comply with ITU-T X.75, layer 3. Military features shall comply with STANAG 4263, Annex D (for layer 3), and ITU-T X.75 (for layer 2).

5.1.3.1.1 Layer 1. The signal at reference point B (NATO) shall comply with the following parameters, as specified in ITU-T G.704.

a. Line code HDB3.

b. BNZS B4ZS, in accordance with ITU-T G.703, the annex titled *Definition of Codes*.

c. Bit rate 2.048 Mbps.

d. Number of channels 32, numbered from 0 to 31. (Normally, 30 channels are used as information-bearer channels, 1 channel is reserved for frame alignment, and 1 channel is reserved for common-channel signaling.)

e. Frame length 256 bits, numbered 1 to 256.

f. Frame repetition rate 8000 frames per second.

g. Frame alignment signal 0011011. The frame alignment signal shall occupy positions 2 to 8 in time slot 0 of every other frame. Bit 2 of time slot 0, in frames not containing the frame alignment signal, shall be fixed at logical one. (See Figure 9.)

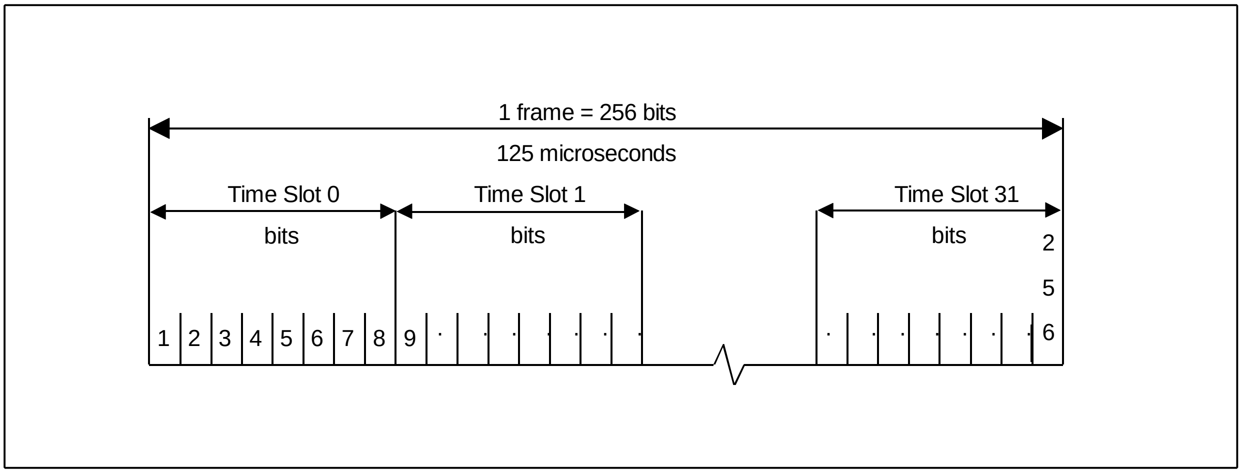


FIGURE 9. Frame format for a 2.048-Mbps signal.

h. Frame alignment signal format See Table IV.

i. High-rate H_0 = 384 kbps.

signals

j. Time-slot assignment — Time slot 16 shall be used to transfer common-channel signaling information (D-channel), when it is present. Time slots 1 to 15 and 17 to 31 are available for allocation to other channels (B or H_0). An H_0-channel may be assigned any 6 time slots in the frame, in numerical order (not necessarily consecutive).

TABLE IV. Allocation of frame bits 1 to 8.

<table>
<tr><th>Bit number
Alternate frames</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th></tr>
<tr><td rowspan="2">Frame containing the frame alignment signal</td><td>Si</td><td>0</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>Note 1</td><td colspan="7">Frame alignment signal</td></tr>
<tr><td rowspan="2">Frame not containing the frame alignment signal</td><td>Si</td><td>1</td><td>A</td><td>Sa4</td><td>Sa5</td><td>Sa6</td><td>Sa7</td><td>Sa8</td></tr>
<tr><td>Note 1</td><td>Note 2</td><td>Note 3</td><td colspan="5">Note 4</td></tr>
</table>

NOTES:
1. Si is the bit reserved for international use. If not used, this bit should be fixed at 1 on digital paths crossing an international border.
2. This bit is fixed at 1 to assist in avoiding simulation of the frame alignment signal.
3. A is the remote alarm indication. In undisturbed operation, it is set to 0; in alarm condition, it is set to 1.
4. Sa4 to Sa8 are spare bits.

k. Signaling data — The signaling data-link bit-rate shall be 56 kbps, evolving to 64 kbps. Fifty-six-kbps signals shall occupy bit positions 1, 2, 3, . . ., 7 of the 64-kbps D-channel. The unused bit position shall be set to "1." The signaling data link shall be a bidirectional transmission path for common-channel signaling, comprising two "data channels" operating together in opposite directions at the same data rate.

5.1.3.1.2 Layer 2. The link-access procedure on the D-channel shall comply with ITU-T Q.921.

5.1.3.1.3 Layer 3. The signaling messages and protocol applicable to the network layer shall comply with ITU-T Q.931.

5.1.3.2 U.S.-tactical to NATO-tactical interface. The interface between U.S.-tactical and NATO-tactical circuit-switched networks

shall comply with STANAGs 4206 to 4212, 4214, and 4290. The network-to-network interface between U.S.-tactical and NATO-tactical packet-switched networks shall comply with STANAG 4249. STANAG 4249 specifies the network-to-network international interface for tactical packet-switched networks. To achieve
DTE-to-DTE interoperability across NATO gateway links requires additional agreements. This is being worked in several NATO technical working groups. The agreement expected will use TCP/IP, which is independent of the underlying subnetworks, including LANS, that may exist in national networks. STANAG 4249 supports both switched virtual circuits (SVC) and permanent virtual circuits (PVC) across NATO gateway links. The SVCs and PVCs will support connectionless IP traffic between terminals on different national subnetworks, as shown in Figure 10.

5.2 Functional profiles. The functional profiles described in 5.2.1 and 5.2.2 apply to host computers (DTEs) that may be connected directly to a local-network element (reference point A) or to a IPR, which is then connected to a common-user network via reference point A. Data communications between DTEs may cross reference points A, B, and B (NATO). Data communications, which cross reference point B (NATO), between a U.S. DTE and a NATO nation DTE shall comply with all STANAGs applicable to layers 4 through 7 of the OSI RM. STANAG numbers are given in 5.2.1 and 5.2.2. The corresponding International Standardized Profile (ISP) classifications are provided. ISO/IEC TR 10000 governs the preparation of ISPs, and MIL-HDBK-829A governs the preparation of Defense Standardized Profiles (DSP).

5.2.1 Application profiles. ISO-based DoD application profiles use protocol standards from ISO RM layers 5-7, to accomplish end-to-end syntax control and application-to-application information exchanges. The actual transfer and control of data, i.e., the bit stream and its management, is accomplished in ISO RM layers 1-4. Sections 5.2.1.1 through 5.2.1.4 provide the application profiles for file transfer, access, and management (FTAM); for the message handling system (MHS); for directory service (DS); and for virtual terminals (VT). These functional profiles are used to ensure interoperability between DoD computers. Part 5 of NIST Special Publication 500-183 provides stable implementation agreements for protocols associated with the upper layers (4-7). The Internet suite of protocols is based on a 5-layer protocol stack. DoD application protocols for the Internet suite of protocols are defined in layer 5, with the actual transfer of data being accomplished in layers 1-4. Section 5.2.1.5 describes the DoD application protocols for the Internet suite. Section 5.2.1.6 identifies the Combat Net Radio application profile.

> [NOTE: FTAM was part of the GOSIP. It is no longer required under POSIT.]

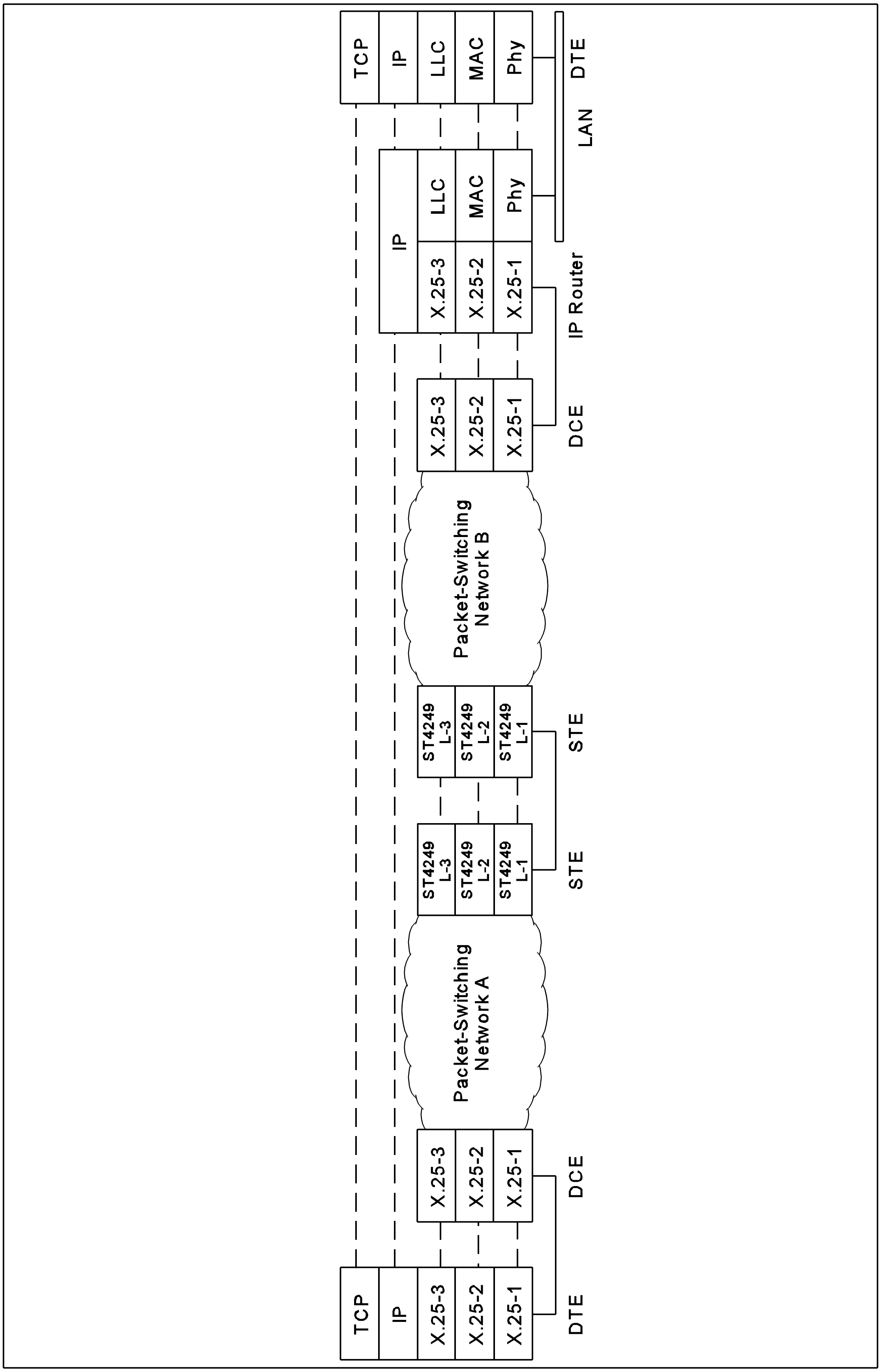


FIGURE 10. U.S.-tactical to NATO-tactical packet-switched network interface.

5.2.1.1 File transfer, access, and management. The FTAM application shall provide the capability to address, access, and manage the movement of information files among users. *File transfer* is the movement of a complete file between ESs. *File access* is the reading, writing, or deleting of selected parts of a file residing on one ES by a user located at a remote ES. *File management* is the remote reading and altering of attributes that define a file. The DSPs for FTAM are specified in MIL-STD-2045-17508, parts 1 through 6. These profiles are based on ISO ISP 10607 parts 1-6. Both profiles define two categories of file transfer: limited-purpose systems and full-purpose systems.

5.2.1.1.1 Limited-purpose system. A limited-purpose system shall implement, as a minimum, the following profiles:

DSP	ISP	DESCRIPTION
MIL-STD-2045-17508-3	AFT 11	Simple File Transfer -- This profile shall enable users to read or write a complete file with unstructured text or a binary set.
MIL-STD-2045-17508-6	AFT 3	Management -- This profile shall enable ES users to manage files within the Virtual Filestore residing remotely.

5.2.1.1.2 Full-purpose system. A full-purpose system shall implement, as a minimum, the following profiles:

DSP	ISP	DESCRIPTION
(DSP not required at this time. Civil standard is sufficient.)	AFT 12	Positional File Transfer -- This profile shall enable users to read or write a single file access data unit or a complete file with sequential text, in addition to the capability provided by the AFT 11 profile. This profile shall be compatible with the Simple File Transfer (MIL-STD-2045-17508/AFT 11) for transfer of unstructured files.
(DSP not required at this time. Civil standard is sufficient.)	AFT 22	Positional File Access -- This profile shall enable users to access files with unstructured text, sequential text, and an unstructured binary set.
MIL-STD-2045-17508-6	AFT 3	Management -- This profile shall enable ES users to manage files within the Virtual Filestore residing remotely.

5.2.1.1.3 Application layer. The FTAM functional profiles shall be supported at the application layer by the following base standards:

ISO 8613 *Office Document Architecture (ODA)*

ISO 8571 *FTAM*

ISO 8650 *Association Control Service Elements (ACSE)*

ISO 8879, 9069, and 9070 *Standard Generalized Markup Language (SGML)*

ISO 8632 *Computer Graphics Metafile*

5.2.1.1.3.1 Office Document Architecture. ISO 8613 (Parts 1, 2, and 4 to 8) specifies rules for describing the logical and layout structures of documents. It also specifies the rules for character, raster, and geometric content of documents so that complex documents can be interchanged. Since the functional profiles addressed are limited to files with unstructured text, sequential text, and an unstructured binary set, no further discussion is provided for the Office Document Architecture (ODA) at this time.

5.2.1.1.3.2 FTAM service elements. The services offered are specified in the MIL-STD-2045-17508 series and defined in ISO 8571. MIL-STD-2045-17508, *Information Technology DoD Standardized Profiles AFTn(D) File Transfer, Access, and Management (FTAM)*, is a series of profiles that defines the specific DoD FTAM requirements and options. In addition, the MIL-STD-2045-17508 series defines which service elements are mandatory versus optional in an effort to ensure interoperability.

5.2.1.1.3.3 Association control service elements. The FTAM shall use ACSEs that are required by all application standards but that do not depend on the specific nature of the standardized application. The ACSE elements of service are specified in MIL-STD-2045-17508-1 and defined in ISO 8649 and ISO 8650. The services in the association category shall include the following: application association establish, application association release (orderly release), and application association abort (disorderly release).

5.2.1.1.3.4 Standard Generalized Markup Language (SGML). ISO 8879 specifies an abstract syntax that expresses the description of a document's structure and other attributes, as well as other information that makes the markup interpretable. ISO 9069 provides the document interchange format, and ISO 9070 provides the registration procedures for public text to be used in SGML support facilities.

5.2.1.1.3.5 Computer Graphics Metafile. ISO 8632 specifies a standard structure for graphics.

5.2.1.1.4 Presentation layer. This layer is associated with Presentation Layer issues being conducted over a Session Layer connection, and is specified in MIL-STD-2045-17508-1 and defined in ISO 8823. STANAG 4256 contains a provision to satisfy NATO military requirements for OSI RM presentation layer service, and STANAG 4266 discusses the provision for the basic NATO military features for the presentation layer protocol. With the interconnection of heterogeneous systems, it is assumed that the service coding is not necessarily the same at both systems.

5.2.1.1.4.1 Abstract syntax. The FTAM presentation entities shall exchange abstract syntax in a precise representational form understood by peer entities for the following abstract syntaxes:

a. ISO FTAM unstructured text (FTAM-1)

b. ISO FTAM sequential text (FTAM-2)

c. ISO FTAM unstructured binary set (FTAM-3)

The abstract syntax is formally defined in ISO 8824, Abstract Syntax Notation 1 (ASN.1), without reference to the use of any encoding technique. The transfer syntax defines the order in which the bytes shall be physically transmitted, including information encryption requirements, compression of recurrent information, or both. Transfer syntax is derived by applying the basic encoding rules for ASN.1 to the abstract syntax defined in ISO 8825 and STANAG 4259. A pairing of abstract and transfer syntax, known as *presentation context*, shall be successfully negotiated between peer presentation entities. The list of negotiated presentation contexts is known as the *defined context set*.

5.2.1.1.4.2 Presentation services. Presentation layer services are specified in MIL-STD-2045-17508-1 and defined in ISO 8822. STANAG 4266 contains provisions to satisfy NATO's military requirement for the OSI RM presentation layer.

5.2.1.1.5 Session layer. The session layer protocol and services are specified in MIL-STD-2045-17508-1. The Session Layer protocol is defined in ISO 8327, and session service elements are defined in ISO 8326. STANAG 4255 contains a provision to satisfy NATO military requirements for OSI RM session layer service, and STANAG 4265 discusses the provision for the basic NATO military features for the session layer protocols. This layer, defined in ISO 8327, is associated with data transfer, control, and management services over a session connection. The intelligence behind the control of session services lies with peer application processes. These processes shall access the session services by use of mirrored services provided through the presentation layer. For the FTAM to function over a session connection, the following functional units shall be available at this layer: kernel, resynchronization, and minor synchronization.

5.2.1.1.5.1 Kernel. The kernel functional unit supports the basic session services of connection establishment, normal data transfer, and connection release.

5.2.1.1.5.2 Resynchronization. The resynchronization function shall be used when a session user determines the information exchange is unreliable and requests that information transfer restarts at a mutually agreed point: the synchronization point serial number. This service originated at the application layer (F-CANCEL) and mirrored through the presentation layer (P-RESYNCHRONIZE). On issuing this request, the application processor shall not invoke any further session service, other than a disorderly termination (F-ABORT), until such time as the confirmation has been received.

5.2.1.1.5.3 Minor synchronization. Minor synchronization points are used to establish commonly understood points in the information exchange within a dialog unit. The FTAM check point service shall be used to provide either the recovery or restart function. The F-CHECK service element shall provide a facility for FTAM to insert check points into the flow of data. The presentation layer mirrors this service element (P-MINOR-SYNC) and becomes S-MINOR-SYNC at the session layer.

5.2.1.2 Message-Handling System (MHS). The MHS application profile addresses store-and-forward electronic messaging between network users. The MHS is defined in ACP 123 U.S. supplement No. 1, and is based on ITU-T X.400. Message Handling Systems (MHS) requiring security services must comply with the MIL-STD-2045-18500 series. New message handling systems requiring security services must comply with the MIL-STD-2045-18500 series. (Note: The AMH9 version is contained in the ACP 123 US Supplement No. 1.)

5.2.1.2.1 Military Messaging Service (MMS). MMS is similar to the Interpersonal Message Service (IPMS) defined in civilian standards but includes extensions for services required in the military environment. The content type used for MMS is P772 (IPMS uses P22).

5.2.1.2.2 Electronic Data Interchange (EDI) service. EDI service shall comply with ITU-T X.435 and applicable portions of NIST Special Publication 500-183 (*Stable Implementation Agreements*).

5.2.1.3 Directory services (DS). DS is specified in ITU-T X.500 (*Blue Book*, 1988). Part 11 of NIST Special Publication 500-183 provides stable implementation agreements for DS protocols. The ISP for DS will comply with the profile classification ADIn, as indicated below:

ADIn	**APPLICABLE STANDARDS**

Layer 7	ITU-T X.500 ISO 8650, Association Control Service Element (5.2.1.1.3.3)
Layer 6	ISO 8823, Connection-oriented Presentation Protocol (5.2.1.1.4)
Layer 5	ISO 8327, Connection-oriented Session Protocol (5.2.1.1.5)

5.2.1.4 Virtual terminal (VT). VT application profiles allow terminals and hosts on different networks to communicate without the hosts having knowledge of specific terminal characteristics. Part 14 of NIST Special Publication 500-183 provides stable implementation agreements of VT protocols. Two categories are defined, as indicated in 5.2.1.4.1 and 5.2.1.4.2.

5.2.1.4.1 Simple system. A simple system is a teletype (TTY)-compatible device that uses a simple line or character at a time and controls characters from the American Standard Code for Information Interchange (ASCII) character set. A simple system supporting the Telnet protocol requires the asynchronous mode (A-Mode) of operation, as indicated below:

ISP	DESCRIPTION
AVT12	A Mode; Telnet -- FIPS-PUB-146 Version 3
AVT13	A Mode; Line Scroll -- FIPS-PUB-146 Version 3
AVT14	A Mode; Paged -- FIPS-PUB-146 Version 3

5.2.1.4.2 Forms-capable system. The forms-capable system supports forms-based applications with local entry and validation of data by the terminal system. Some of the functions supported are cursor movement, erase screen, and field protection. The forms profile requires the synchronous mode (S Mode) of operation and specifies simple delivery control. A forms-capable system shall support the forms profile specified in section 14.8.3 of the Workshop Agreements. The corresponding Workshop Agreements with FIPS-PUB-146, Version 2, limits the forms-capable system to the A Mode. The S Mode should be addressed when the FIPS-PUB-146, Version 3, is released. The applicable standards are shown below:

AVT2n	APPLICABLE STANDARDS
Layer 7	ISO 9040, VT ISO 8650, Association Control Service Element (ACSE) (5.2.1.1.3.3) ISO XXXX, Remote Operations Service Element (ROSE)

Layer 6	ISO 8823, Connection-Oriented Presentation Protocol (5.2.1.1.4)
Layer 5	ISO 8327, Connection-Oriented Session Protocol (5.2.1.1.5)

5.2.1.5 Application protocols. Protocols for the Internet suite are defined in 5.2.1.5.1 through 5.2.1.5.4.

5.2.1.5.1 Telnet. Telnet is the TCP/IP standard for remote connection service. Telnet allows a user at one site to interact with a remote timesharing system at another site, as if the user's terminal connected directly to the remote machine. Implementation shall be in accordance with MIL-STD-2045-17506.

5.2.1.5.2 File transfer protocol. File transfer protocol (FTP) is the TCP/IP standard high-level protocol for transferring files from one machine to another. FTP uses Telnet and TCP protocols. The server side requires a client to provide a login identifier and password before it will honor requests. Implementation shall be in accordance with MIL-STD-2045-17504.

5.2.1.5.3 Simple mail transfer protocol. Simple mail transfer protocol (SMTP) is the TCP/IP standard protocol for transferring electronic mail messages from one machine to another. SMTP specifies how two machines interact and the format of control messages they exchange to transfer mail. Implementation shall be in accordance with the Internet Message Transport Profile, as defined in the MIL-STD-2045-17503 series.

5.2.1.5.4 Domain name system. The domain name system (DNS), an on-line distributed database system, is used to map human-readable machine names into IP addresses. DNS servers throughout the connected internet implement a hierarchical namespace that allows freedom in assigning machine names and addresses. DNS also supports separate mappings between mail destinations and IP addresses. Implementations shall be in accordance with MIL-STD-2045-17505.

5.2.1.6 Combat net radio. MIL-STD-2045-47001 specifies a connectionless data-transfer application profile for use in combat radio networks.

5.2.2 Transport profiles. Transport profiles identify the use of base standards for OSI RM layers 1 through 4 to provide information transfer between transport entities. The transport profiles are limited to providing connection-oriented transport service (COTS).

5.2.2.1 Transport service. The transport service, which provides communications from one application program to another, is called end-to-end service. The transport service provides reliable transport, ensuring that data arrives without error and in sequence, thus shielding the application program from the vagaries of the interconnecting network(s).

5.2.2.1.1 Transport protocols. The Internet suite standard transport protocol is the connection-oriented protocol, Transmission Control Protocol (TCP). For setting up transport connections, TCP uses the connectionless protocol UDP (User Datagram Protocol). UDP may also be used for time-sensitive best-effort transport service. Both TCP and UDP are specified in MIL-STD-2045-14502-1. To meet the evolutionary requirements for existing DoD network protocols, MIL-STD-2045-14503 shall be used to obtain OSI end-to-end services over TCP/IP-based networks. The profile specifies TP0 on top of TCP. TP0 functions as the transport service convergence protocol and provides a packet orientation on top of the TCP octet stream, while using the TCP's end-to-end service.

5.2.2.1.2 Security protocol. Message security service (MSP) provides military messaging (MM) and MHS writer-to-reader security services. The writer may select encryption, electronic signature, and nonrepudiation services. End-to-end security is currently provided by external COMSEC devices until (NLSP) and (TLSP) have evolved. MSP defines for an X.400 message a new message content type that includes a security heading and the original content type. MSP does satisfy the requirements for classified messages and is currently intended to be used with (GENSER) unclassified messages. It is independent of the message content being protected. MSP provides security services for X.400-based electronic messaging, but may also be used as a secure message encapsulation facility with other message environments. MIL-STD-2045-48501 is a DSP that identifies the format for the common security label used to exchange security attributes.

5.2.2.2 Supporting networks. COTS shall be supported by either a connectionless network (see 5.2.2.2.3) that provides connectionless network service (CLNS), or a connection-oriented network (see 5.2.2.2.4) that provides connection-oriented network service (CONS). COTS shall have a common network addressing structure (see 5.2.2.2.1).

5.2.2.2.1 Network addressing. Two standard addressing formats are used for connectionless networks: One for IP router networks, and the other for OSI networks.

5.2.2.2.1.1 Addressing for IP router networks. Addressing for IP router networks shall comply with MIL-STD-2045-14502-1. IP router networks are used extensively in DISN. Connections between IP routers are normally pre-established using leased lines. In the future network managers will use a connection-mode technology such as ATM to establish connections between IP routers.

5.2.2.2.2 Addressing for OSI networks. The second addendum to the network service, ISO 8348, defines network layer addressing. To maintain the transparent goals of the OSI RM, a network address makes no implications about the physical location of a node, nor does a network address contain explicit routing information. The OSI strategy is to use a hierarchically structured address. At the top level, an address shall be divided into two parts: an initial domain part (IDP) assigned by the ISO/IEC, and a domain specific part (DSP). The IDP is further subdivided into two parts: the authority and format identifier (AFI) and the initial domain identifier (IDI). Table V provides the AFI values assigned by ISO/IEC as a function of the IDI format. The AFI values are a function of the DSP syntax, indicating either decimal or binary. The maximum IDP length in digits is also provided.

TABLE V. AFI values.

IDI FORMAT	AFI VALUE DSP SYNTAX		IDP MAXIMUM LENGTH
	DECIMAL	BINARY	
ITU-T X.121	36, 52	37, 53	16
ISO 3166 DCC	38	39	5
ITU-T F.69	40, 54	41, 55	10
ITU-T E.163	42, 56	43, 57	14
ITU-T E.164	44, 58	45, 59	17
ISO 6523 ICD	46	47	6
NON-ALIGNED	48	49	2

The ISO/IEC assigned the international code designator (ICD) to NIST and the data country code (DCC) to ANSI. The System and Network Architecture Division at NIST determines how Government agency-specific identifications are assigned and registered at the national level. NIST has delegated the management responsibility to the Telecommunications Customer Service Division within the General Services Administration (GSA). Currently, the GSA is defining the registration procedures as well as usage guidelines. The AFI value of decimal 47 specifies that the IDI part is interpreted as a 4-decimal-digit ICD and that the DSP has a binary abstract syntax. The IDI, set to 5 for the entire Government's use (including DoD and the DSP address structure), is defined in FIPS-PUB-146-1, section 5.1.1. NIST applied for and obtained an ICD equal to 6 for DoD use. The DSP is undefined.

5.2.2.2.3 Connectionless network. A connectionless network is one in which there is no requirement to establish a connection between users. Since no connection exists between users, the network address shall be included explicitly with every transfer request. Wide-area networks (WAN), such as the Defense Data Network (DDN), use internetwork protocol (IP) to provide connectionless network service. Most of the commercially available connectionless networks are configured within a localized geographical area known as a LAN. These LANs are often capable of transmitting data at very high rates. This is made possible because the physical medium is installed between systems located in proximity. COTS over CLNS service shall be in accordance with MIL-STD-2045-13500 and MIL-STD-2045-13501.

5.2.2.2.3.1 Network protocols. The Internet Relay Profiles defined in MIL-STD-2045-13500 and MIL-STD-2045-13501 shall be used. Implementation of the security option shall require the assignment of new parameter values to the Reason for Discard parameter in the error reporting, as defined in FIPS-PUB-146-1. The NIST IR90-4250 SP3 (submitted to ANSI for adoption) shall be used to define the security option at the network layer. This standard shall be implemented in intermediate gateway systems, as well as DTEs. The security protocol encapsulates the TPDU, but first adds network addresses to the protocol header for network routing, adds an integrated code if integrity is required, encrypts the entire TPDU if required, and then puts the result in a secure encapsulation of the TPDU.

5.2.2.2.3.2 Link service. The link service provided over a LAN shall be a Type-1 connectionless network service. The link layer of the OSI RM shall be divided into two sublayers. The logical link control (LLC) shall establish, maintain, and terminate the logical link between devices, and the media access control (MAC) shall regulate access to the medium. Part 2 of NIST Special Publication 500-183 provides stable implementation agreements for protocols related to subnetworks.

5.2.2.2.3.2.1 Logical link control. For LANs, the LLC shall comply with ISO 8802-2 to provide a connectionless subnetwork service to support connectionless network protocols. The LLC shall be used to maintain the logical link between devices. The LLC generates command packets (or frames) called protocol data units (PDU), and interprets them. The unacknowledged connectionless service shall allow the network entities to exchange link service data units without a data-link level connection. The data transfer can be point-to-point, multicast, or broadcast.

5.2.2.2.3.2.2 Media access control. The MAC sublayer in LANs handles the methods for allowing a particular node to transmit on the data transmission channel available to it. A LAN can be configured as either a bus or a ring topology. Furthermore, two primary methods are used to control access: carrier sense multiple access/collision detection (CSMA/CD) and token passing. The ISO 8802-3 standard addresses CSMA/CD, ISO 8802-4 addresses token-passing buses, ISO 8802-5 addresses token-passing ring, and ISO 9314 addresses FDDI.

5.2.2.2.4 Connection-oriented network. A connection-oriented network is based on the ability to reserve a connection through a network for the duration of the network connection. ISPs for COTS over CONS are in ISO ISP 10609 (9 parts).

5.2.2.2.4.1 Network service. The network service for a connection-oriented network is defined in ISO 8348. STANAG 4253 contains provisions to satisfy NATO's military requirements for OSI RM network layer service. The network service is in one of three phases at any one time: connection establishment, data transfer, or connection release.

5.2.2.2.4.2 Network protocols. Protocol combinations to provide connection-oriented network service shall be as defined in ISO 8880, Appendix 2, which identifies the protocols used to realize the ITU-T X.25 packet-level protocol (PLP) over the subnetwork. ISO 8878 defines the use of ITU-T X.25 PLP to provide the OSI connection-oriented network service. ISO 8208 defines the packet format and control procedures for the exchange of packets that contain control information and user data at data terminal equipment (DTE). ISO 8208, Addendum 2, defines the dial-up access to a packet-switched public data network through a public switched telephone network (PSTN), an integrated-services digital network, or a circuit-switched public data network. ITU-T Q.931 defines additional signaling requirements during set-up of an incoming call when D-channel access is required on the ISDN. Part 3 of NIST Special Publication 500-183 provides stable implementation agreements for network protocols. STANAG 4263 contains the military features required for NATO's network layer protocols.

5.2.2.2.4.3 Data-link service. Data-link service for a connection-oriented network shall use the LAPB protocol, as defined in ISO 7776. STANAG 4252 contains provisions to satisfy NATO's requirements for OSI RM data-link layer service.

5.2.2.2.4.4 Data-link protocols. DTEs that are directly connected or use dial-up access to the packet-switched public network shall use the LAPB protocol, except for connection to the ISDN D-channel. For access via the ISDN D-channel, the LAPD protocol shall be used as defined in ITU-T Q.921. The LAPD protocol is a fully standard implementation of the ISO High-level Data Link Control (HDLC) protocol, as described by the following documents: ISO 7809, ISO 4335, ISO 3309, ISO 8471, and ISO 8885. Part 2 of NIST Special Publication 500-183 provides stable implementation for protocols related to subnetworks. STANAG 4262 contains the features required for NATO's data-link layer protocols.

5.2.2.2.4.5 Physical layer. For non-ISDN application, or for the R interface of ISDN applications using terminal adapters, MIL-STD-188-114 shall be used for the physical layer interface. MIL-STD-188-114 is based on EIA 422 and 423 and is interoperable with EIA 232 (formerly RS-232), and the ITU-T V.35 digital interface referenced in FIPS-PUB-146. For ISDN, the basic rate interface (BRI) at the S and T reference points shall comply with ANSI T1.605. STANAG 4251 contains provisions to satisfy NATO's military requirements for OSI RM physical layer service, and STANAG 4261 contains the military features for NATO's physical layer protocols.

5.3 Subscriber-network elements. General requirements for subscriber-network elements are listed in 4.5.2.1. The implementation of narrowband ISDN and in the future broadband ISDN (B-ISDN) requires a substantial investment in the upgrade of the DISN. To take advantage of DISN features requires that direct digital capabilities be provided to all subscriber-network elements. These subscriber elements are discussed in 5.3.1 through 5.3.4.2.2 on the basis of their access requirements: direct, mobile, universal, and indirect.

5.3.1 Direct access. Direct access may be provided by copper wire, coaxial cable, or fiber optic cable. The access method depends on the bandwidth to be supported. This entails developing all-digital subscriber-terminal equipment with direct access that can provide voice; high-speed data communications; facsimile (text and graphics); still and motion video communications; as well as high-resolution television broadcast.

5.3.1.1 Voice. All voice end terminals shall provide voice digitization. Strategic user terminals shall use 64-kbps PCM or 32-kbps ADPCM. Tactical user terminals shall have the capability to interface, either directly or via a switch, using 16-kbps (optionally 32-kbps) CVSD analog-to-digital (A-D) conversion, as defined in MIL-STD-188-113. Voice terminals employing CELP shall be capable of providing 4.8-kbps CELP A-D conversion, as defined in FED-STD 1016. The voice digitization algorithm shall be negotiated during the call-establishment phase, and the 4.8-kbps CELP shall be the preferred mode. Military satellite (in the anti-jam mode) and HF radio applications shall use 2.4-kbps LPC.

5.3.1.2 Data. All end terminals that provide data communications shall be capable of supporting all application profiles, as defined in 5.2.1.

5.3.1.3 Facsimile. All end terminals that provide text and graphics in the form of facsimile shall conform to MIL-STD-188-161. STANAG 5000 addresses the protocols that are necessary for facsimile subsystems to work in a noise environment.

5.3.1.4 Video teleconferencing. All end terminals that provide video teleconferencing service shall comply with COS VTC001.

5.3.1.5 High-definition television. High-definition television (HDTV) standards are under development for end terminals that provide the HDTV function.

5.3.2 Mobile access. Due to rapid advances in signal processing and integrated circuit technology, digital radio has become a viable technology for implementing wireless subscriber loop service in remote areas; for providing wireless private branch exchange (PBX) service; for cellular digital mobile radio service; for digital mobile satellite service; and for tactical digital radio network service.

All subscriber-network elements requiring mobile access shall have a default voice algorithm of 4.8-kbps CELP, and the gateway function at reference point A shall allow for data traffic with bit count integrity (BCI) to support both secure voice and data. Standards for mobile access are under development. NSA has been leading the Government effort to create standards within industry that support interoperable voice and data communications via mobile subscriber interfaces.

5.3.2.1 Wireless subscriber loop service. Standards for remote wireless subscriber loop service are under development.

5.3.2.2 Wireless PBX service. New low-power, short-range digital radio (average transmitter power in the order of 10 mW technologies are being developed. The use of digital multiplexing with demand assignment multiple access (DAMA) of digital radio links could service multiple user terminals. Time-division multiple access (TDMA) standards for cellular digital mobile radio service (see 5.3.2.3) may also be viable for multiple-user applications.

5.3.2.3 Cellular digital mobile radio service. Standards are being developed for next-generation cellular digital mobile radio systems. [The Special Mobile Group (GSM) of the European Telecommunications Standards Institute (ETSI) is standardizing a pan-European TDMA mobile radio technology. The Telecommunications Industry Association (TIA) and Cellular TIA (CITA) are standardizing an entirely different technology for North America. It is expected that these two efforts will converge to enhance interoperability.]

5.3.2.4 Digital mobile satellite service. Digital mobile satellite service will be based on Ultra Small Aperture Terminal (USAT) technology with a 10- to 12-inch antenna diameter. USAT requires complex hybrid spread-spectrum modulation and access techniques to limit interference. The information rate is limited to 2.4 kbps, ruling out the use of the default 4.8-kbps CELP voice algorithm for this service. Standards are under development for end terminals requiring service over digital mobile satellite links.

5.3.2.5 Tactical digital radio network service. Standards for HF radio subsystems are listed in 4.4.2.8. Standards for HF radio subscriber networks are under development. Planning standards for HF are contained in MIL-STD-187-721. Standards for HF radio automatic link establishment (ALE) and HF automatic operation in stressed environments are provided in MIL-STD-188-141. Standards for HF store-and-forward service will be contained in FED-STD-1047. Standards for automatic HF networking to multiple transmission media will be contained in FED-STD-1048.

5.3.3 Universal access. Universal access will allow subscribers to initiate and receive calls through the DISN, irrespective of their geographical location. Two basic concepts related to universal access are emerging: the mobile communications facility offered by the Universal Mobile Telecommunications System (UMTS), and the personal communications facility offered by the Personal Telecommunications Service (PTS). Standards for universal access are under development.

5.3.3.1 Universal Mobile Telecommunications System (UMTS). The UMTS shall provide mobile communications, not only by keeping track of the location of mobile subscribers (by storing information about their current location), but also by maintaining ongoing calls and connection, despite their movement.

5.3.3.2 Personal Telecommunications Service (PTS). The PTS shall be provided across multiple networks and allows network-independent user identification. From a network point of view, the PTS may be based on either a wired or wireless interface.

5.3.4 Indirect access. End terminals may be configured on a LAN or a group of LANs joined by bridges to form an extended LAN.

5.3.4.1 Local area network. End terminals configured to a LAN at the network layer shall use connectionless network protocols, as defined in MIL-STD-2045-13500 and MIL-STD-2045-13501; at the link layer, end terminals shall use logical link control type-1, as defined in ISO 8802-2. End terminals at the MAC level that require CSMA/CD shall conform to ISO 8802-3. End terminals at the MAC level that require token-passing bus access shall conform to ISO 8802-4. End terminals at the MAC level that require token-passing ring access shall conform to ISO 8802-5. End terminals at the MAC level that require FDDI access shall conform to ISO 9314. ANSI X3.229 addresses station management for FDDI. FDDI LANs provide broadband service to end users. This service may be extended via broadband networks (see 5.4). End terminals at the MAC level that require broadband service (see 5.4.2) shall conform to IEEE 802.6.

5.3.4.2 Bridges. A bridge connects at the data-link level to forward packets between local networks. A bridge operates at the logical link or MAC layer (layer 2 of the ISO RM), independent of higher-level protocols. A bridge architecture can be based on either a transparent spanning tree or on source routing.

5.3.4.2.1 Transparent-spanning-tree bridge. A transparent-spanning-tree bridge shall modify its address table dynamically for each packet it receives. If a station address is unknown, the bridge shall flood all links other than the link over which the packet was received. A transparent-spanning-tree bridge can function as either a local or remote MAC bridge. A local MAC bridge directly connected to LANs shall conform to IEEE 802.1D. A remote MAC bridge directly attached to one or more LANs, and also to an unspecified interconnection medium, shall conform to draft standard IEEE P802.1G/1D. The MAC frame is encapsulated within the appropriate interconnecting medium for transmission across the network to a peer remote bridge.

5.3.4.2.2 Source-routing bridge. In a source-routing bridge the route shall be determined by the source station for each frame sent through one or more bridges to the destination station. The routing information is contained within each frame and used by each bridge it transitions over. Source-routing information shall be acquired by the originating station, by broadcasting a request that is updated by each bridge it transitions over. Multiple copies received by the destination station are sent back to the originating station, and the information is used to select the preferred path. A source-routing bridge shall conform to
ISO 8802-5.

5.4 Broadband service support. Broadband service support within the DISN shall comply with network interface transport rates, formats, and architectures associated with digital hierarchies defined in ANSI T1.105.

5.4.1 Transport digital hierarchy. In support of broadband services, two primary digital hierarchy standards are applicable: ANSI T1.105 and ITU-T G.707. Within CONUS, the ANSI T1.105 Digital Hierarchy Optical Interface Rates and Formats Specification, commonly referred to as SONET, defines the layer 1 Synchronous Optical Hierarchy (SOH). ITU-T G.707 through G.709 define the layer 1 Synchronous Digital Hierarchy (SDH) for international use. Where common rates and formats exist, the SONET standard is functionally and structurally equivalent to ITU-T G.707.

5.4.1.1 Synchronous Optical Network. The primary objective of SONET is the definition of a SOH with sufficient flexibility to support transmission rates and formatted signals. Any signal transmitted using ANSI T1.105 shall employ ANSI T1.106 to provide opto-electrical conversion.

5.4.1.1.1 Rates. Where necessary, support of various low transmission rates across a high-rate connection shall be accomplished through the employment of synchronous multiplexing. Multiplexing results in a family of standard rates and formats, which are multiples of the basic 51.84-Mbps Synchronous Transport Signal Level 1 (STS-1) rate. To support broadband services, primary rate signals may be time-division multiplexed to build higher transmission rates. SONET shall support sub-STS-1 rate signals by multiplexing these lower-rate signals in accordance with ANSI T1.105. SONET rates applicable to the DISN are listed in Table VI.

TABLE VI. SONET rates.

STS-M	BIT RATE (MBPS)
STS-1	51.840
STS-3	155.520

TABLE VI. SONET rates.

STS-12	622.080
STS-48	2488.320

NOTE: STS-M = Synchronous Transport Signal-Level M

5.4.1.1.2 Frame format. Figure 11 depicts the STS-M frame structure. For M=3, each of 9 rows of the STS-M frame consists of 9 octets of transport overhead, 1 octet of path overhead, and 260 octets of user traffic payload.

5.4.1.1.3 Services. The SONET standard can support a variety of connection-oriented and connectionless transport data services. (The services that SONET supports include DS3 telecommunications signals; video; and low-rate telephone services, such as DS1, DS1C, or DS2 signals). The following SONET concatenated rates shall be supported: STS-3C, STS-12C, and STS-48C.

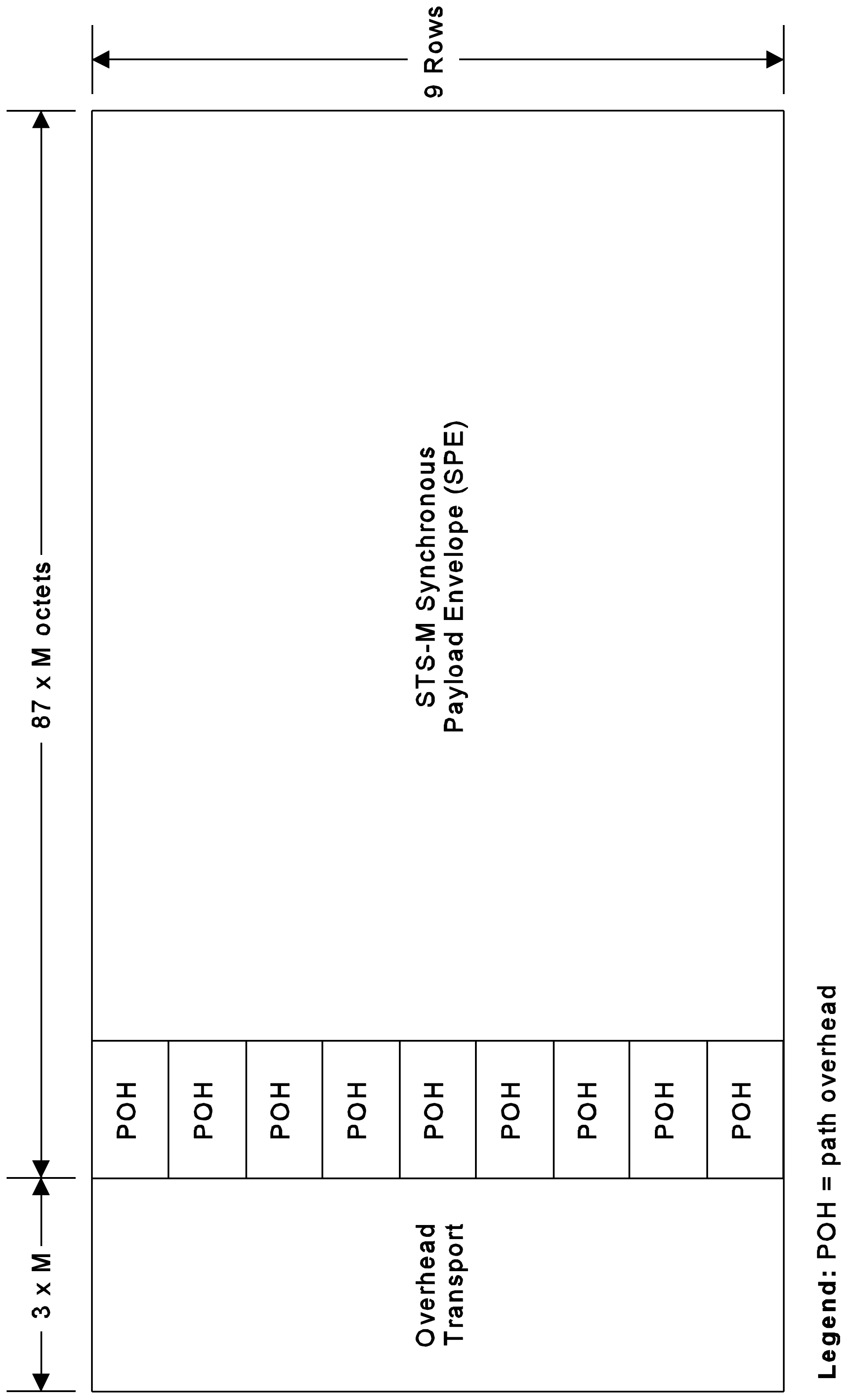


FIGURE 11. SONET STS-M frame format.

5.4.1.1.4 Management. The SONET standard incorporates embedded operations channels within its overhead field. These are referred to as the Line, Section, and Path Data Communications Channels (DCC). These embedded channels shall be used to provide communications capacity to support DISN integrated network management. To facilitate the reliable transport of management traffic, the DCC shall be multiplexed into the STS-M frame to support link integrity. In addition, the DCC will use a standardized data communications profile to promote interoperability between SONET network elements. The purpose of this profile is to support the interoperation of operations, administration, maintenance, and provisioning (OAM&P) systems. See Table VII for the appropriate profile.

TABLE VII. Profile for TL1/CMIP over the DCC

Layer	Reference
Application CMISE ROSE ACSE	ISO 9595/9596 ITU-T X.219/X.229 ITU-T X.217/X.227
Presentation	ISO 8823
Session	ISO 8327
Transport TP4	ISO 8073
Network CLNP • ES-IS • IS-IS	ISO 8473 ISO 9542 ISO 10589
Data Link LAPD	Q.921
Physical Data Communications Channel	ANSI T1.105

5.4.1.1.5 Automatic protection switching. The automatic protection switching protocols for linear network topologies, using SONET, are specified in ANSI T1.105. The protection switching protocols and algorithms for bidirectional line-switched network topologies are addressed in ANSI T1.105.01.

5.4.1.1.6 Jitter at network interfaces. Jitter specification at SONET network interfaces shall comply with ANSI T1.105.03.

5.4.1.1.7 SONET network element timing and synchronization. The synchronization related performance parameters for all SONET network interfaces shall comply with ANSI T1.105.09.

5.4.1.2 Synchronous Digital Hierarchy

5.4.1.2.1 Rates. The SDH supports broadband services as a layer 1 capability. Table VIII shows the applicable SDH rates. The basic SDH rate of 155.520 Mbps is designated STM-1. Other rates are derived by multiplexing the basic rate in accordance with ITU-T G.708 and G.709.

In accordance with ITU-T G.709, provisions shall be made to support sub-STM-1 rates.

TABLE VIII. ITU-T G.707 rates (Mbps).

STM-N	BIT RATE (Mbps)
STM-1	155.520
STM-4	622.080
STM-16	2488.320*

NOTES:
* = This rate is under study by the ITU-T.
STM-N = Synchronous Transport Module-Level N

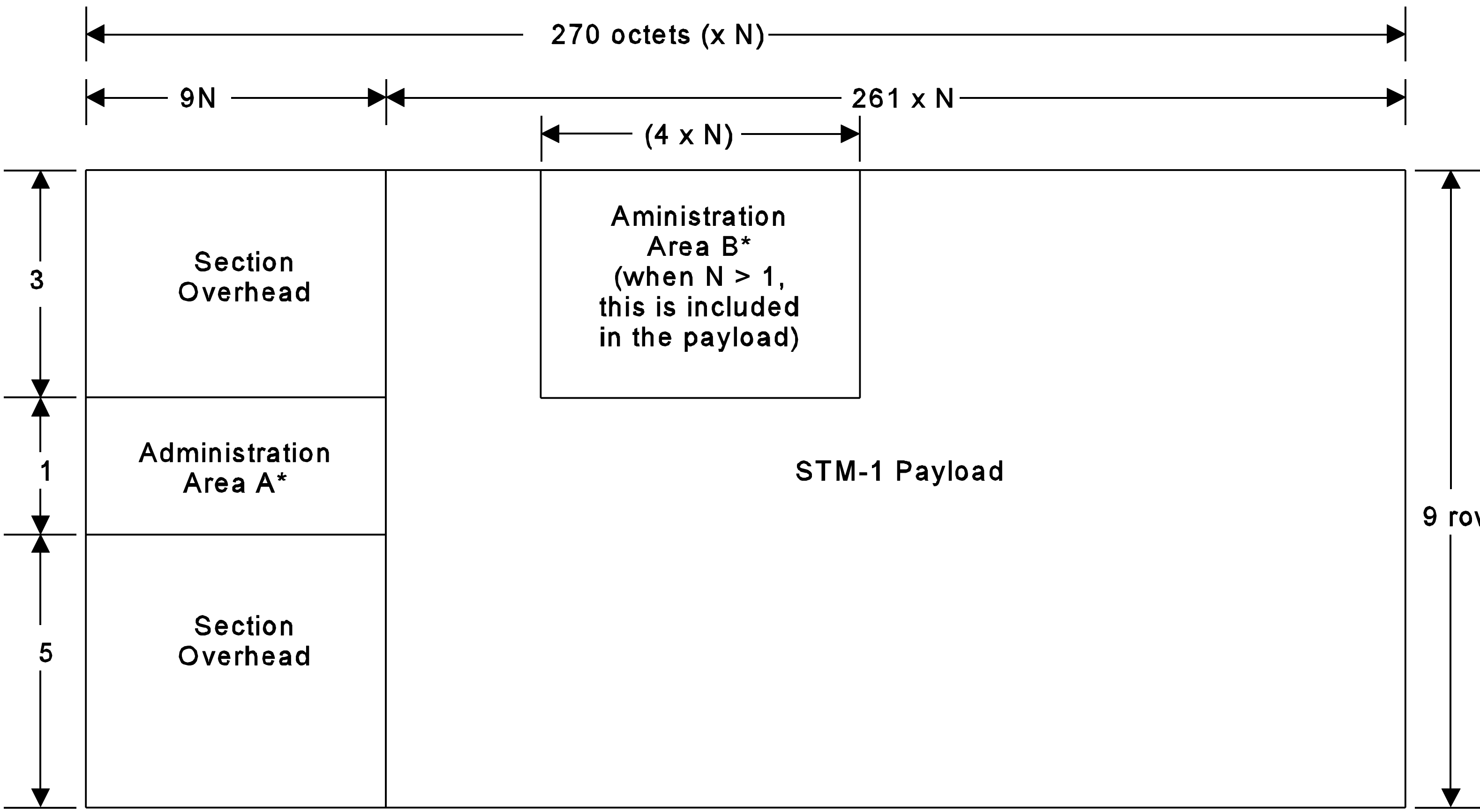
5.4.1.2.2 Frame format. Figure 12 illustrates the STM-N frame format. For N=1, the STM-1 frame shall consist of 93 octets of overhead and 2337 octets of payload. An STM-N (where N>1) consists of 81 x N octets of overhead and 2349 x N octets of payload.

5.4.1.2.3 Services. The SDH shall support all services defined in 5.4.1.1.3.

5.4.1.2.4 Management. Network management services shall be supported via an embedded service channel within the SDH overhead structure. The SDH service channels shall support DISN network management objectives, as specified in 5.7.

5.4.2 Metropolitan area networks. The DISN shall support IEEE 802.6 DQDB subnetworks. To support broadband services across large areas, multiple DQDB subnetworks may be interconnected to form MANs. MANs may be suitably interconnected to form wide-area networks (WAN). By definition, MANs are subscriber-network elements within the DISN.

The primary objective of MANs shall be to establish a transparent and reliable (low delay and no loss of user throughput capacity) mechanism for interconnecting LANs. A transparent MAN environment is one in which two or more interconnected LANs appear as a single, logical LAN to their respective users.



* The Administration area is used to manage the organization of payload information within the frame.

FIGURE 12. ITU-T STM-N frame format.

5.4.2.1 Services. The DQDB subnetwork is a distributed multi-access network that supports integrated communications services. Specifically, the DQDB supports connectionless data transfer, connection-oriented data transfer, and isochronous communications (such as voice). In support of connectionless services, Appendix B of IEEE 802.6 provides information on a mechanism for controlling bus communications between nodes. Currently, DQDB/MAN-related services are planned as a public offering within the continental United States (CONUS). Outside CONUS, the DQDB/MAN architecture and its services will be supported as a private subscriber network element.

Connectionless packet service shall support variable-length packet service. The connection-oriented data service shall support a virtual channel between any pair of data service users. The MAN reference model used to support these services is depicted in Figure 13.

5.4.2.2 Rates. The MAN will support IEEE 802.6 DQDB/MAN high-speed transport of information across interconnected IEEE 802.6 DQDB subnetworks within the DISN. Transport of information will be achieved through the use of a 53-octet cell-based format. (The cell length is equivalent to that of an ATM cell.) A DQDB/MAN located outside CONUS shall be interconnected via a SONET/ITU-T G.707 rate interface.

The rates supported are as defined in ITU-T G.703 (at 34.368 and 139.264 Mbps) and ITU-T G.707 (at 155.520 Mbps). Lower-rate interfaces shall be supported via multiplexing, in accordance with ITU-T G.709.

5.4.2.3 Architecture. Multiple DQDB subnetworks may be interconnected to form MANs via mediation devices (bridge, router, or gateway). MANs may be viewed as a public or private (that is, DoD) backbone network. Figure 14 shows a notional interconnection of public and private MAN networks.

5.4.2.3.1 DQDB subnetwork architecture. A DQDB subnetwork uses a pair of unidirectional buses (a dual-bus pair), referred to as Bus A and Bus B. Bus A and Bus B are independent from the point-of-view of data flow. That is, information on the buses flows independently in opposite directions.

A DQDB subnetwork shall support either an open dual-bus or a looped dual-bus. In the open dual-bus topology, the head of Bus A and the head of Bus B are logically separate. In the looped-bus topology, the head of Bus A and the head of Bus B are collocated.

Within the DQDB subnetwork, adjacent nodes shall be physically interconnected by two separate transmission links. Each transmission link shall carry management and user traffic. Eight levels of priority are supported by the DQDB standard. These levels of priority are shared between network and user traffic.

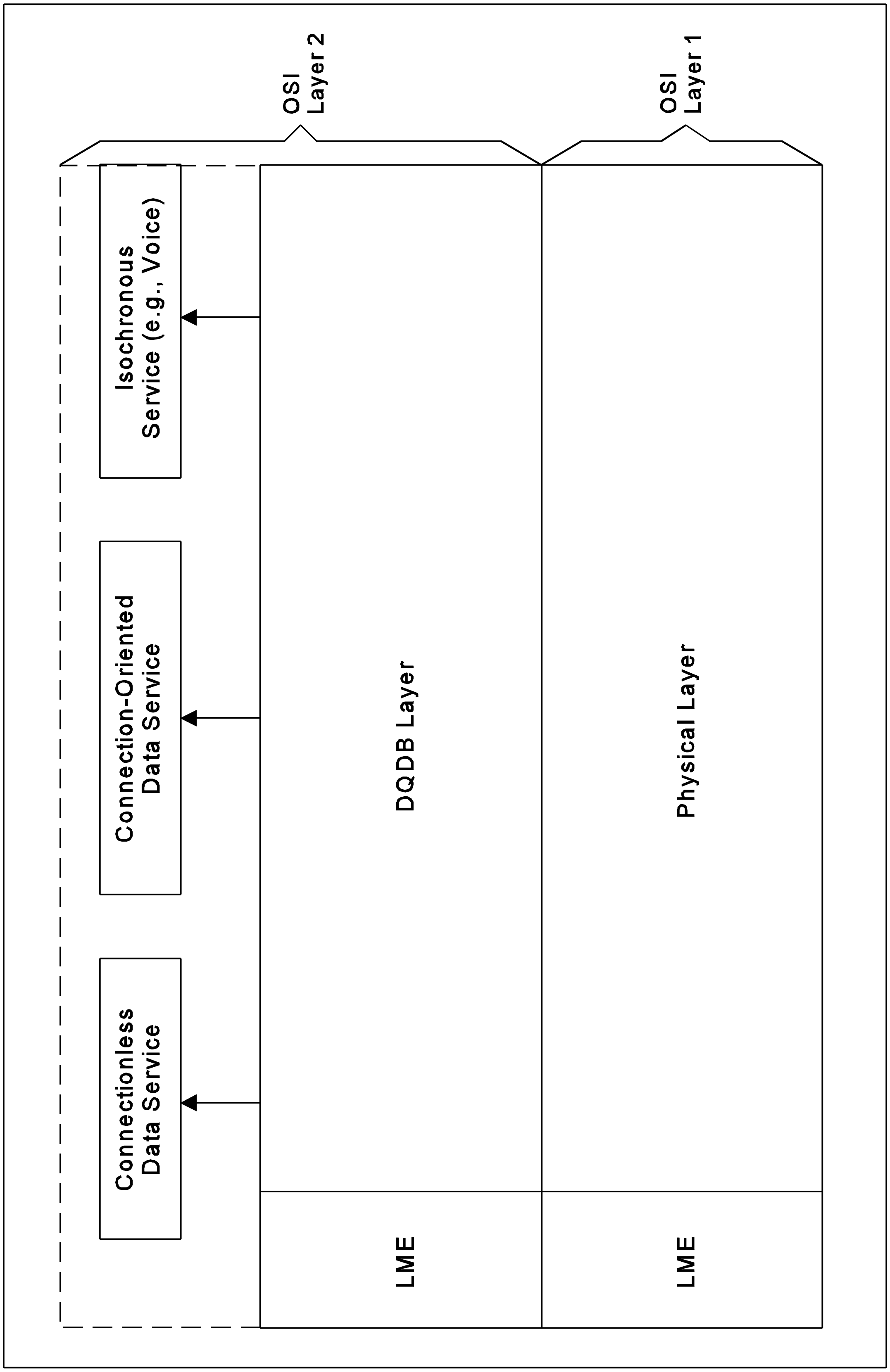


FIGURE 13. IEEE 802.6 layer reference model.

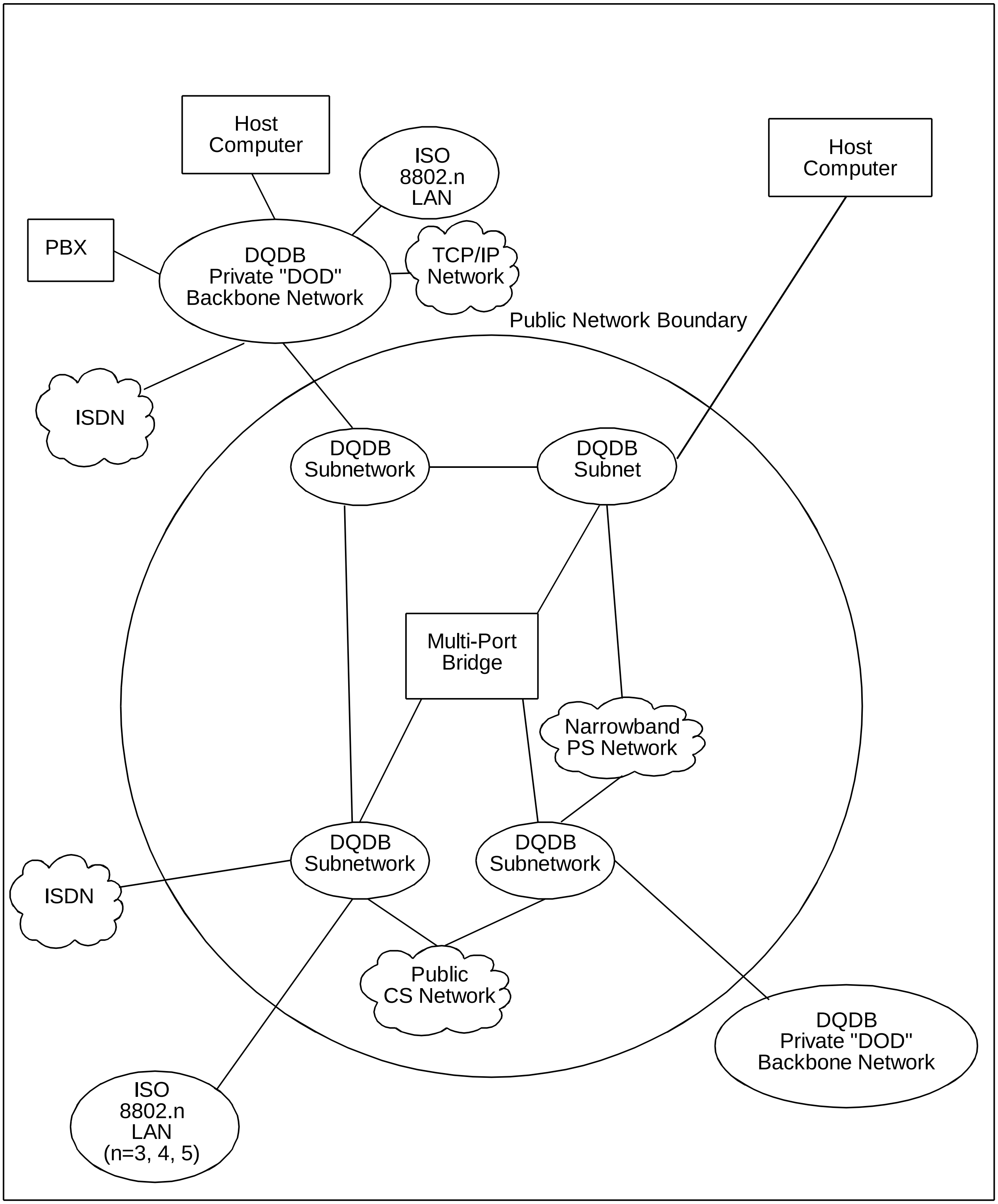


FIGURE 14. Notional internetworking network architecture.

5.4.2.4 DQDB/MAN interworking. In support of broadband interworking within the DISN, the DQDB/MAN architecture and protocols shall be used to support any combination of LAN and ISDN connectivity (for example, LAN-LAN, LAN-ISDN-LAN).

To simplify LAN/MAN interworking, the IEEE 802.6 subnetwork has been designed to be compatible with other LANs at OSI layer 2. Figure 11 depicts a typical scenario in which DQDB/subnetworks are interworking with a variety of other LANs, public and private networks, and ESs (hosts and terminal equipment). Interworking of DQDB subnetworks with ATM networks is simplified by the common use of a fixed-size 53-octet cell, consisting of a 48-octet information field and a 5-octet header.

5.4.2.5 Protocol. The DQDB shall employ management and traffic protocols to control and monitor access and use of its resources. To support integrated DISN network management, the DQDB/MAN shall provide for local and remote management and control of its resources.

5.4.2.5.1 Local node management. Local node management is not subject to the OSI management definition, since all information flow is local to the node's management process. However, when MANs are interconnected via a DISN local- or wide-area network element, the local management shall conform to the management concept defined in 5.6.

5.4.2.5.2 Remote management via network/system management. A node's physical and data-link layer objects are monitored, controlled, and coordinated via DISN network management through the DQDB-layer management interface. System management application functions shall provide for monitoring, control, and coordination of managed objects through interaction with the DQDB-layer management interface.

5.4.2.5.3 Remote management via DQDB layer management. Remote management shall provide for remote monitoring, control, and coordination of managed objects within a local node.

5.4.3 Broadband ISDN. The chosen transport technology for B-ISDN is the asynchronous transfer mode (ATM), a connection-oriented technique that can be used for supporting both connectionless and connection-oriented services. Signaling and user information are carried on separate virtual channels. The ATM transport service shall comply with ITU-T I.321, I.361, I.363, and I.432, as specified below.

5.4.3.1 B-ISDN services. Based on commercially available standards, B-ISDN shall support a variety of user services, including voice, video, data, and signaling. Service parameters shall be negotiable call-by-call, subject to network constraints and limitations on parameter ranges.

5.4.3.1.1 Cell-relay bearer service. Cell-relay bearer service (CRBS), the basic service provided by ATM, is a connection-oriented, sequence-preserving, cell transfer service between two or more broadband terminals (BT). CRBS is defined at the UNI for a single BT. Multiple on-demand virtual connections can be provided to one or more BTs via an ATM network. CRBS is defined to operate between ATM layer entities in BTs, providing for transparent transfer of ATM cells.

5.4.3.1.2 Voice. For end-to-end encrypted voice calls, and for nonsecure voice calls between deployed and fixed subscribers, constant bit rate (CBR) shall be used.

NOTE: In ATM networks there is a delay associated with filling cells with bits from a voice encoder. The lower the voice-encoding rate, the longer the delay. For example, at 64 kbps the delay is 6 ms. At 16 kbps the delay is 24 ms. Just as with satellite links, the delay of concern for conversation is the round-trip delay; thus CVSD-16 would introduce 48 ms of added round-trip delay. This is less than 10% of the round-trip delay experienced on a 1-hop satellite link.

One technique for alleviating delay is to partially fill cells. This will reduce the throughput; however, this may be an acceptable way to reduce delay for low-bit-rate voice, such as 2.4 or 4.8 kbps.

In networks using 2-wire analog telephones, excess delay can cause echo problems. However, echo is not expected to be a problem in networks using digital telephones.

5.4.3.1.3 Video. CBR may be used for noncompressed and compressed video, using AAL 1 (see 5.4.3.3.3). VBR may be used for compressed video, using AAL 5 (see 5.4.3.3.3).

5.4.3.1.4 Data. VBR shall be used for data transmission. A version of VBR called available bit rate (ABR) requires that a peak cell rate (PCR) and a minimum cell rate (MCR) be negotiated at connection time. The user may not exceed the PCR, and the network guarantees the MCR. Specifications for ABR are still being worked by the ATM Forum.

5.4.3.2 ATM cell attributes. ATM cell format and transfer rates shall comply with 5.4.3.2.1 and 5.4.3.2.2.

5.4.3.2.1 Cell format. The ATM shall be based on the cell structure shown in Figure 15. Cells are of fixed size, 53 octets, consisting of a 5-octet header field and a 48-octet user information field. Any control information pertaining to the user application is carried in the user information field. The cell header shall conform to ITU-T I.361. It is the same at the UNI and NNI, except for the first 4 bits. These shall be reserved for generic flow control (GFC) at the UNI, and as an extension of the virtual path indicator (VPI) field at the NNI. UNI refers to the interface at both reference points A and B. NNI refers to the interface between nodes of a network. The GFC field shall be set to "0000".

5.4.3.2.2 Cell loss priority. The purpose of the cell loss priority (CLP) field is to indicate relative priority of cells within a single-user information stream. The lower cell-loss

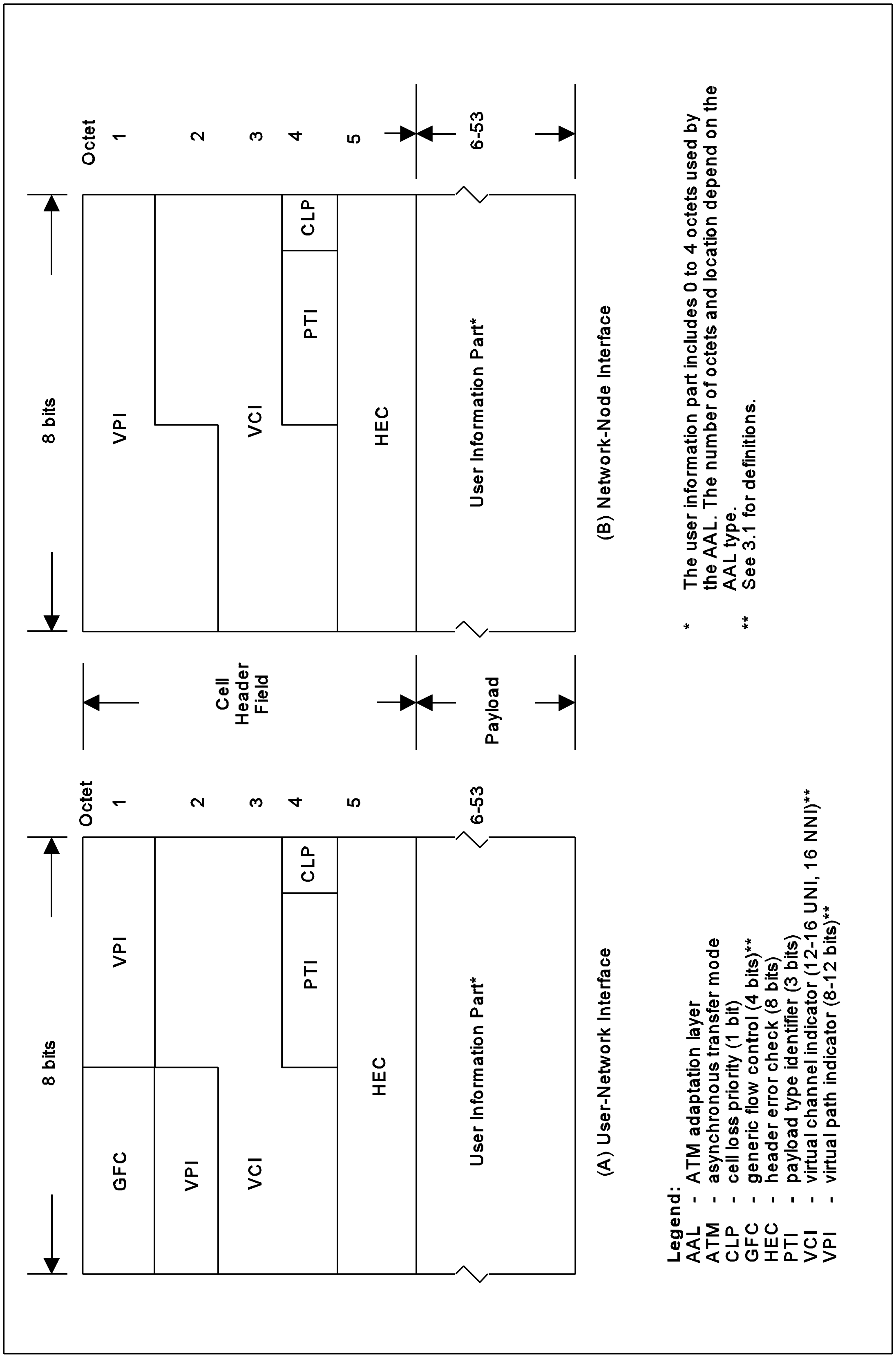


FIGURE 15. ATM cell structure.

priority cells may be discarded during periods of congestion. Delivery of higher loss priority cells is not guaranteed; however, other measures shall be used to avoid discarding higher-loss priority cells.

5.4.3.3 ATM reference model. Figure 16 depicts the ATM layered protocol reference model (ATM-RM). The specific layers related to the ATM functions are the physical layer and ATM layer, which are common to all services and provide cell transfer capabilities, and the ATM adaptation layer (AAL), which is service-dependent. The ATM layer uses cell header information to transfer the cell payload field through the ATM network. AAL layer functions are user-service-dependent and operate only on information contained in the payload field.

5.4.3.3.1 Physical layer. The physical layer, which provides transmission services to the ATM layer, consists of two sublayers. The physical-media-dependent (PMD) sublayer includes only physical-media-dependent functions. The transmission convergence (TC) sublayer shall perform all functions required to transform a flow of cells into a flow of bits, which can be transmitted and received over a physical medium, in accordance with ITU-T I.432. Applicable SONET rates are shown in Table IX. STS-Nc indicates that the group must be treated as a single entity and may not be transported as N-independent STS-1s. Lower-rate physical layer interfaces applicable to both UNI and NNI are given in 5.4.3.3.1.1 to 5.4.3.3.1.3.

Table IX. Applicable SONET rates

SONET DESIGNATION	BIT RATE (Mbps)	UNI	NNI
STS-1	51.84	Yes	Yes
STS-3c	155.52	Yes	Yes
STS-12c	622.08	No	Yes
STS-48c	2488.32	No	Yes

5.4.3.3.1.1 DS3 based interface (44.736 Mbps). ATM cells are direct mapped into the DS3 payload with the octet structure of the cells aligned with the nibble structure of the DS3 M-frame. The M-frame is organized such that 84 bits of payload follow every overhead bit, in accordance with ANSI T1.107. ATM cells may cross M-frame boundaries. The bit rate available for the transport of ATM cells in the DS3 direct mapped format shall be nominally 44.21 Mbps.

5.4.3.3.1.2 E1 based interface (2.048 Mbps). The E1 interface shall use the basic frame structure shown in Figure 9 and defined in ITU-T G.704. ATM cells shall be mapped into time slots 1 through 31 of the E1 frame so that the octet structure of the ATM cells is aligned with the octet structure of the E1 frame. Timeslot 0 is reserved for frame alignment signals.

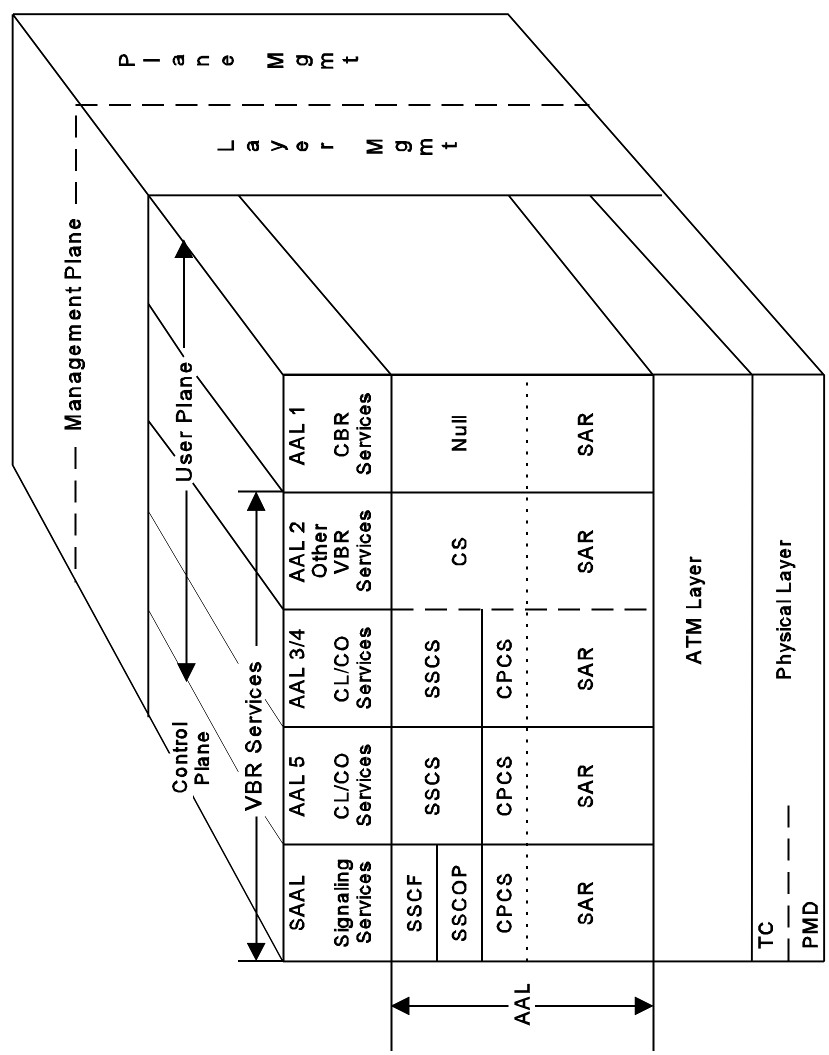


FIGURE 16. ATM protocol reference model.

5.4.3.3.1.3 DS1 based interface (1.544 Mbps). The DS1 interface shall use the extended super frame (ESF) format with the multiframe structure defined in ANSI T1.107. ATM cells shall be mapped into the 192-bit payload field of the DS1 frame so that the octet structure of the ATM cells is aligned with the octet structure of the DS1 frame.

5.4.3.3.2 ATM layer. The ATM layer provides connection-oriented network service to the layers above. After a virtual connection has been established (see 5.4.3.5), the ATM layer transfers cells in accordance with their virtual path indicators (VPI) and their virtual channel indicators (VCI), in accordance with ANSI T1.627.

5.4.3.3.3 ATM adaptation layer. The AAL performs the necessary functions to adapt the services provided by the ATM layer to the services required by different Service users. The AAL supports higher-layer functions of the user and control planes, and shall support connections between ATM and non-ATM users. It shall support both CBR and VBR services. The AAL consists of two main sublayers: the segmentation and reassembly (SAR) sublayer and the convergence sublayer (CS). The SAR sublayer is common to CBR and VBR services, and handles the segmentation and reassembly of data units so they can be mapped into the fixed-length payloads of the ATM cells. The CS provides the specific service-related functions of the AAL and may be divided into two sublayers, the common-part convergence sublayer (CPCS) and the service-specific convergence sublayer (SSCS). VBR services support connection-oriented and connectionless data services for a range of applications from burst data to VBR. VBR services also support signaling. CBR services include voice, video, and circuit emulation. Adaptation layer protocols, AAL 1-5 for user services and SAAL for signaling, are described below (see Figure 16).

AAL 1. AAL 1 provides a 47-octet user payload, with a 1-octet header to support timing and sequence integrity. AAL 1 supports CBR applications in which a timing relationship is required to exist between source and destination, such as voice or video, and shall comply with ANSI T1.630, section 11.1.2. This mode is referred to as circuit emulation, and is commonly used for transport of multiplexed circuits such as DS-1. To maintain BCI, dummy cells are inserted whenever the receiving entity identifies a lack of received cells from the ATM layer.

AAL 2. AAL 2 supports VBR applications in which a timing relationship is required to exist between source and destination, such as compressed video. This service has not been standardized.

AAL 3/4. AAL 3/4 supports both CLNS and CONS data transfer. It provides for the transparent and sequential transfer of protocol data units (PDU) between corresponding upper-layer entities with an agreed QOS. The transfer may provide either assured or non-assured data transfer, as requested by the user. Each cell carries 44 payload octets, with a 2-octet header and a 2-octet trailer, in accordance with ANSI T1.629 for the CPCS. The header provides protection against missordering of cells, and multiplexing identification. AAL 3/4 supports optional multiplexing of multiple CPCS connections over a single connection between ATM entities. The trailer provides a cell payload length indication and a 10-bit CRC for cell error detection. For assured service, LAPD may be used in the SSCS for PDU retransmission. For non-assured service, the SSCS is null. Optional error discard allows corrupted PDUs to be delivered to the user.

AAL 5. AAL 5 supports services identical to AAL 3/4, but provides a 48-octet payload. No error detection is provided in the cell. There is also no mis-sequencing protection at the cell level; therefore, it can be used only for point-to-point service and cannot provide multiplexing of connections. A 32-bit CRC for error detection is provided at the CPCS, in accordance with ANSI T1.635. For assured service, the SSCS shall provide sequencing and retransmission of erroneous CPCS PDUs. Optional error discard allows corrupted PDUs to be delivered to the user. For non-assured service, the SSCS is null.

Signaling ATM adaptation layer. The signaling AAL (SAAL) conveys signaling information between layer 3 entities across the UNI and NNI. The SSCS is divided into two sublayers: the service-specific coordination function (SSCF) and the service-specific connection-oriented protocol (SSCOP). The SSCF maps the services of SSCOP to the needs of the layer 3 protocol, in accordance with ITU-T Q.2130 for the UNI, and Q.2140 for the NNI. The SSCOP provides assured data delivery for the signaling PDUs, in accordance with ANSI T1.637. The SSCOP shall use the services of the SAR and CPCS from AAL 5.

5.4.3.3.4 B-ISDN signaling. Signaling at the UNI shall be based on the ITU-T Q.2931 protocol. ITU-T Q.2931 supports point-to-point network connections. Point-to-multipoint network connections shall be in accordance with ITU-T Q.2971. Signaling shall use the SAAL protocol. A service-specific connection-oriented protocol (SSCOP), a sublayer of the SAAL protocol, will provide reliable delivery of signaling messages. SAAL shall be the link layer protocol for use across international interfaces for B-ISDN signaling. Signaling at the NNI shall be based on ITU-T Q.2761 to Q.2764. B-ISDN signaling shall support CBR services, and both connection-oriented and connectionless VBR services. B-ISDN signaling shall permit connection of users on B-ISDN to connect to users on N-ISDN. ATM signaling shall also permit users on different N-ISDNs to interconnect via B-ISDN.

5.4.3.4 ATM service support. ATM shall support a variety of transport services, such as frame relay and SMDS. These services may be provided on top of AAL 3/4 or AAL 5. ATM shall also support connection to N-ISDN services at the UNI.

5.4.3.5 ATM interworking. ATM connections shall support ISDN user and signaling services. ATM networks shall support interworking with other ATM networks and non-ATM networks. Between ATM networks, interconnection will be at the cell level. When interworking with non-ATM networks, interconnection will be via an ATM adapter. Interconnection with N-ISDN networks will also require an ATM adapter. The adapter may be implemented via an external ATM device, or in the ATM switch.

5.4.3.6 Application of ATM in tactical systems. The ATM concept is an integrating concept in that it enables all types of information, from voice to data to video, to be handled by common transmission and switching facilities. DoD's high level of interest in ATM for tactical systems is driven by the desire for seamless integration of fixed and deployed resources. Commercial standards for ATM are based on the availability of highly reliable (BER = 10^{-11}), high bandwidth (50 Mbps to Gbps) transmission facilities (fiber, cable, SONET). However, tactical channels may be characterized as low bandwidth and unreliable. These include radio links in the low Mbps range (DS1) with BERs of 10^{-5} or worse. Tactical radio links at VHF and HF have even less bandwidth and worse BERs. In traditional packet-switched networks, data links are made reliable by means of error detection and retransmission at each network node. In ATM networks, retransmission is not done at each node; it is done only end-to-end across the network, or end-to-end between user end devices. The connections through deployed ATM networks are likely to traverse multiple radio links. The end-to-end error probability will approach the sum of the individual link error probabilities, causing excessive retransmission and severe reduction of throughput when deployed radios are used. For this reason FEC shall be provided in deployed radio links to reduce the number of retransmissions. Selection of FEC for deployed ATM networks depends on the transmission media.

5.4.3.7 ATM LAN. Based on technology advancements, an ATM LAN is an alternative to a DQDB subnet. ATM switches can be configured to form a MAN for interconnection of LANs and direct connection of user end devices. Standards specifying use of ATM are identified in 5.4.3.

5.4.3.8 LAN emulation over ATM. LAN emulation enables a group of ATM-attached stations to be logically analogous to a group of LAN stations attached to a carrier sense multiple access collision detection (CSMA-CD) or token ring LAN. LAN emulation provides the same connectionless and multicast services as the

LAN being emulated. LAN emulation service provides connectivity not only between ATM-attached stations, but also with stations attached to legacy LANs. This includes connectivity both from ATM stations to LAN stations, as well as from LAN stations to LAN stations across an ATM network. ATM Forum's *LAN Emulation Over ATM* - Version 1.0 defines LAN emulation for two types of legacy LANs: CSMA-CD/ISO 8802-3 and Token Ring/ISO 8802-5. Communications between stations attached to different LAN types is possible only through routers or bridges.

5.4.4 Frame relay mode. The DISN shall support the frame relay mode (FRM). Support of FRM within the DISN shall conform to ANSI T1.606, for the ISDN FRM bearer service definition and architectural framework. The ANSI FRM definition is closely aligned with ITU-T Q.922. Frame relay interworking with B-ISDN shall be in accordance with ANSI T1.633 and T1.634.

5.4.4.1 Services. Although the ANSI FRM is, by definition, an ISDN packet mode bearer service, the FRM service may be used with any suitable low-bit-error-rate transport service such as ATM.

The FRM supports a variety of connection-oriented transport data services. These services shall support the following DISN service access methods when working over ISDN:

a. Circuit-switched access to the DISN network element's remote frame handler (FRM-Case A). The B- and H-channels may be used to send FRM data with this access method.

b. Virtual access via the DISN network element's local ISDN connection (FRM-Case B). The B-, H-, and D-channels may be used to send FRM data with this access method.

It shall be possible to establish access connections on demand and permanently, in accordance with ANSI T1.617. Multiplexing of multiple subscriber data streams onto a single connection shall be performed at the link layer, in accordance with ANSI T1.618.

5.4.4.2 Rates. The FRM shall have the capability of using the strategic-local network B-, H-, and D-channels and tactical-local network bit rates from 16 kbps to 2.048 Mbps. When using the basic rate ISDN interface, the FRM shall operate at the 64-kbps rate. The FRM use of the D-channel shall be at either the basic (16-kbps) or the primary (64-kbps) rates. The D-channel rates apply only to the FRM-Case B. Higher rates may be used when connected via B-ISDN.

5.4.4.3 Format. The FRM frame format shall be as depicted in Figure 17 and defined in ANSI T1.618. The fields identified in the figure are described as follows:

Flag: Each frame contains a beginning and closing high-level data link control (HDLC) flag. The flags are used to indicate the beginning and end of a negotiated packet of user information. One flag may be used to indicate the end of one frame and the beginning of the next.

Address: The address field is used to support routing and network status (such as congestion) control information.

Control: The FRM does not employ the HDLC control field.

Bits 8	7	6	5	4	3	2	1	Octet
0	1	1	1	1	1	1	0	1
Address Field (High-Order Octet)								2
(Low-Order Octet) (Optional)								3
Frame Relay Information Field								4 to (n - 3)
Frame Check Sequence Field (First Octet)								n - 2
(Second Octet)								n - 1
Flag Field 0	1	1	1	1	1	1	0	n

FIGURE 17. Frame format for frame relay mode.

Frame Relay Information:	The information field shall support the transport of a defined amount of user information. The default information field size is 262 octets (chosen to be compatible with LAPD. The minimum frame relay information field size is 1 octet. The support by networks of a negotiated maximum value of at least 1600 octets is recommended for applications such as LAN interconnect, to minimize the need for segmentation and reassembly (SAR) by the user equipment.
Frame Check Sequence:	The frame check sequence (FCS) is used to provide error checking. The FCS is defined to be a 16-bit sequence.

5.4.4.4 Management. The FRM provides no intrinsic network management capability. Thus, the FRM shall be managed as a layer 1 and layer 2 service, in accordance with relevant portions of 5.6.

5.4.4.5 Interworking. The FRM shall support interworking between tactical-local network and strategic-local networks. Interworking via the FRM shall support LAN-to-LAN and terminal-to-terminal interconnections. The FRM may also take advantage of broadband transport services to traverse non-FRM network segments.

5.5 Personal communications services (PCS). Standardization efforts for PCS are currently in a state of flux, due to the rapidly evolving technologies that support them. Nevertheless, some basic commercial standards are emerging. A variety of standards for second-generation implementations of terminal mobility are currently in use. Their aim ranges from preserving compatibility with first-generation implementations to introducing new technologies such as code-division multiple access (CDMA). The ITU has therefore embarked on an effort to curtail proliferation and achieve global mobile terminal access by the beginning of the next century. The emerging recommendations for this third-generation implementation of PCS should be used as guidance for implementing PCS in the DISN. These recommendations are covered under the titles Future Public Land Mobile Telecommunications System (FPLMTS) and Universal Personal Telecommunications (UPT).

5.5.1 Wireless access. The wireless access portion of systems supporting terminal mobility includes several areas of standardization:

a. air interface, which sets parameters for transmission, modulation, and channelization;

b. the means for acquiring a channel and adjusting its capacity;

c. specific signaling formats and messages, and the protocols necessary to establish connections; and

d. basic information structure and protection of information.

5.5.1.1 Current standards. Shown in Table X are a number of standards that describe all or parts of the air interface standards for cellular mobile systems now in use or proposed for use in the United States. Included is the U.S. version of the European DCS-1800 system, an upshift version (1.8-2.0 GHz) of the European GMS cellular system (900 MHz). Also included is the low-power PCS-2000 standard, intended for hand-held mobile terminals in the micro-cell environment.

TABLE X. Current air interface standards in the U.S.

T1P1-DOC	STANDARD	BAND (GHz)	ACCESS/ DUPLEX	MODULATION	POWER (W)	RATE (kbps)
	IS-54	.9	TDMA/FDD	DQPSK	.8-3	48.6
94-087	IS-136	1.8-2.2	TDMA/FDD	DQPSK	.6-1	48.6
94-086	DCS-1800	1.8-2.0	TDMA/FDD	GMSK	.25-2	13.0
94-088	IS-95+	1.8-2.0	CDMA/FDD	DQPSK	.1-2	14.4
94-089	PCS-2000	1.8-2.2	TDMA/TDD	DSSS/CPSQM	.01	8.0

LEGEND:

TDMA	time-division multiple access
CDMA	code-division multiple access
FDD	frequency-division duplexing
TDD	time-division duplexing
DQPSK	differential quadrature phase-shift keying
GMSK	Gaussian minimum shift keying
DSSS	direct-sequence spread spectrum
CPSQM	continuous phase-shift quadrature modulation (proprietary)

5.5.1.2 Future standards. The ITU is now working on a third-generation standard for FPLMTS. The aim of this effort is to achieve better compatibility among the various cellular systems such that, by the beginning of the next century, universal global access supporting terminal mobility becomes a reality. The document now emerging from this effort shall be used as guidance for implementing global terminal mobility in the DISN. The approved or draft recommendations that were shown in the ITU subgroup reports as of March 1995 are listed in Table XI.

TABLE XI. List of ITU recommendations for FPLMTS.

RECOMMENDATION	SUBJECT/TITLE
M.687-1	Future Public Land Mobile Telecommunication Systems (FPLMTS)
M.816	Framework for services supported on FPLMTS
M.817	FPLMTS network architectures
M.818-1	Satellite operation within FPLMTS
M.819-1	FPLMTS for developing countries
M.1034	Requirements for the radio interface(s) for FPLMTS
M.1035	Framework for the radio interface(s) and radio subsystem functionality for FPLMTS
M.1036	Spectrum considerations for implementation of FPLMTS in the bands 1885-2025 MHz and 2110-2200 MHz
M.1078	Security principles for FPLMTS
M.1079	Speech and voiceband data performance requirements for FPLMTS
FPLMTS.TMLG	Vocabulary of terms for FPLMTS (Draft)
FPLMTS.FMGM	Framework of FPLMTS management (Draft)
FPLMTS.RSEL	Procedure for evaluation of radio transmission technologies for FPLMTS (Draft)
FPLMTS.SFMK	Framework for the satellite component of FPLMTS (Draft)
FPLMTS.SECMOP	Security mechanisms and operating procedures for FPLMTS
F.115	Service objectives and principles for FPLMTS
F.sfea	Service features in FPLMTS (Draft)
F.724	Videotelephony services for FPLMTS (Draft)
E.751	Reference connections for engineering of land mobile networks (Draft)
E.771	Network grade-of-service parameters and target values for circuit-switched public land mobile services (Draft)
E.780	Traffic engineering methods for land mobile systems (Draft)
M.32xx	TMN management service for FPLMTS
Q.FNA	FPLMTS network architecture (Draft)
Q.FIF	FPLMTS information flows (Draft)
I.11x	Vocabulary of terms for mobile networks (Draft)
I.37w	Network architecture and capabilities of FPLMTS (Draft)
I.5xw	Network interworking between FPLMTS and other types of networks (Draft)
G.728	Coding of speech at 16 kbps using low-delay code-excited linear prediction (CELP)
H.26P/M	Extension of H.263 for mobile application (Draft)

5.5.2 Network access. Network access standards govern the protocols and procedures for establishing connections among mobile terminals and between them and fixed terminals of a switched network (or mobile terminals of a different cellular system). IS-41, the current standard within the United States, provides this capability and is compatible with the existing signaling and numbering schemes used in public switched telephone networks (PSTN). As intelligent network features are added to the PSTNs, standards will be evolving to more readily and efficiently achieve global access for all mobile terminals. DISN shall, in the future, make use of the more general standards for universal access (see 5.5.3), which include not only mobile terminals, but also all forms of personal mobility.

5.5.3 Universal access. Universal personal telecommunications (UPT) is the purpose of universal access. It allows a user to gain access to a variety of authorized (subscribed) services without limiting his personal and/or terminal mobility. All authorized services will be available to the user irrespective of his location on the globe, limited only by the capabilities of the terminal he uses and the network with which he is associated.

The ITU is now working on UPT standards. DISN shall make use of these standards and adopt them for military users. The current ITU Recommendations (approved or in draft) are listed in Table XII.

TABLE XII. ITU recommendations for universal personal telecommunications.

RECOMMENDATION	SUBJECT/TITLE
F.850	UPT service principle
F.851	UPT service set 1
F.852	UPT service set 2
F.853	UPT supplementary service
E.168	UPT numbering
E.174	Routing principle and guidance for UPT
E.755	Reference connections for UPT
E.775	UPT grade-of-service concept
E.776	Grade-of-service parameters for networks supporting UPT
E.785	Traffic engineering methods for networks supporting UPT
D.280	Charging, billing, accounting, and reimbursement for UPT
Q.76	Service procedures for UPT
Q.UPT	Stage 3 for support of UPT service set 1 on IN CS1
I.144	Vocabulary-UPT
I.137	UPT network capabilities

5.6 DISN network management. The DISN network management system shall comply with FIPS-PUB-179 for all but unique military features. The implementation of the unique military features shall comply with MIL-STD-2045-38000 and the companion MIL-HDBK-1351. The DISN network management features are described in 5.6.1 through 5.6.2.5.

5.6.1 Management communications. DISN network management communications protocol and services, which provide the management information-transfer mechanism, shall comply with FIPS-PUB-179, the sections titled *Common Management Information Protocol (CMIP)* and *Common Management Information Services (CMIS)*. If an interim solution is required, the Simple Network Management Protocol (SNMP) shall be used, as defined in MIL-STD-2045-17507. A complete coverage of CMIP and CMIS can be found in ISO 9596-1 and ISO 9595, respectively.

5.6.2 Military-unique features. MIL-STD-2045-38000 builds upon FIPS-PUB-179 by describing common military architectures and requirements, manageable computer and communications resources, and associated NM system solutions unique from the GNMP. The military-unique features are described in 5.6.2.1 to 5.6.2.5.

5.6.2.1 NM architecture. The DISN shall be partitioned into a number of management domains called NM system domains. Allocations are typically based on organization or geography. Management authority shall be assigned to a single network control center (NCC) within each NM system domain. NCCs shall be responsible for interfacing with other NM system domains (see Figure 18) as well as providing top-level management within their own NM system domain (see Figure 19), in accordance with MIL-HDBK-1351, the section titled *NM architecture*.

5.6.2.2 NM system characteristics. Human engineering (ergonomics), automated analysis tools, and administrative activities shall comply with MIL-HDBK-1351, the section titled *NM system characteristics*.

5.6.2.3 Systems management functional areas. The DISN NM system shall provide the following five systems management functional areas (SMFA), in accordance with MIL-HDBK-1351, the section titled *Systems management functional areas*:

a. Fault management. NM systems shall detect faults, isolate the causes, and correct the abnormal operation or fault situation of network components.

b. Configuration management. Dynamic configuration of networks shall provide tactical communications; interbase communications; and interconnection with external networks through bridges, gateways, and routers.

c. Account management. Details regarding use of the network shall be collected, recorded, and archived for the appropriate distribution of costs.

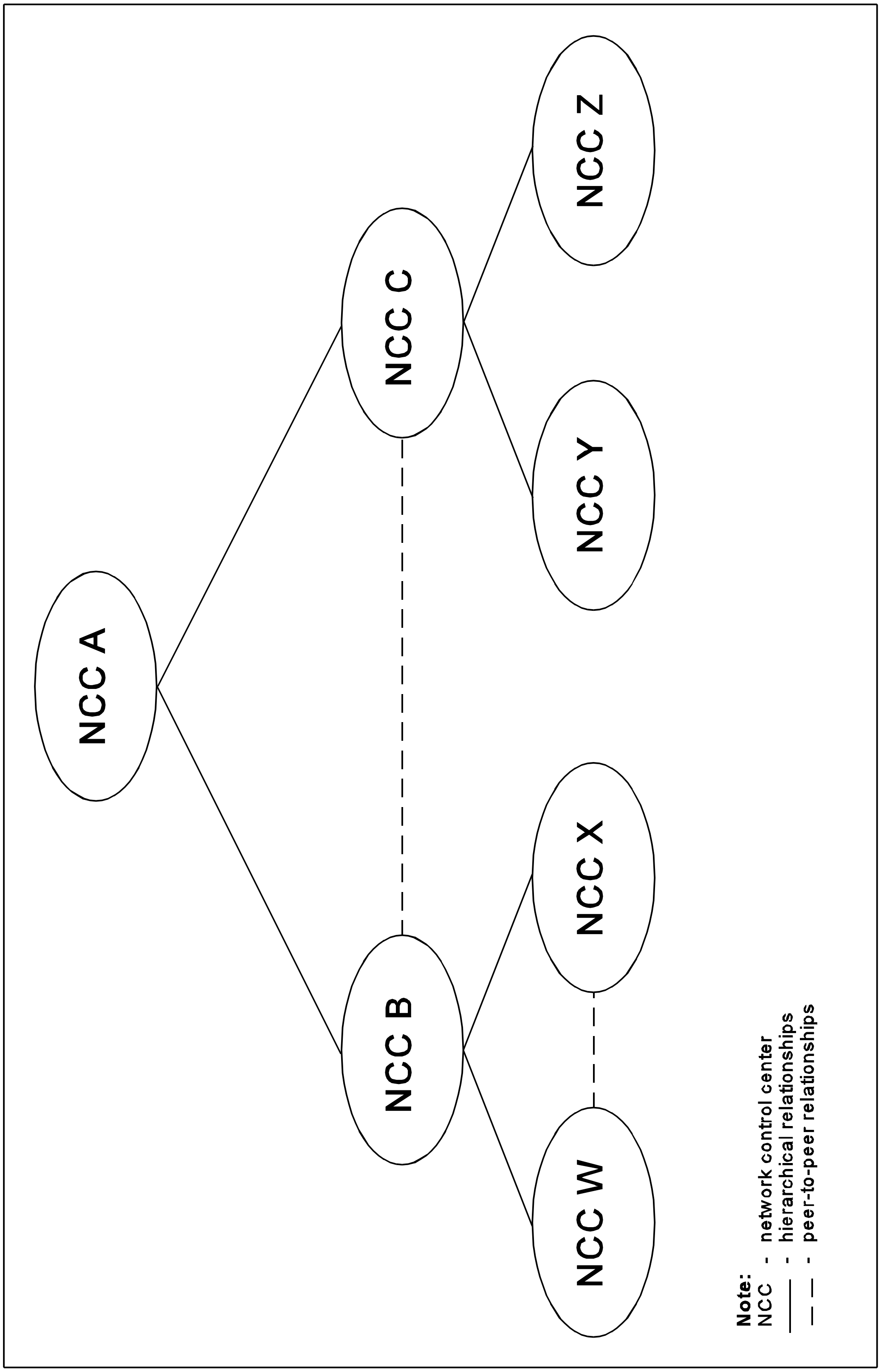


FIGURE 18. Hierarchical structure (manager-of-managers method).

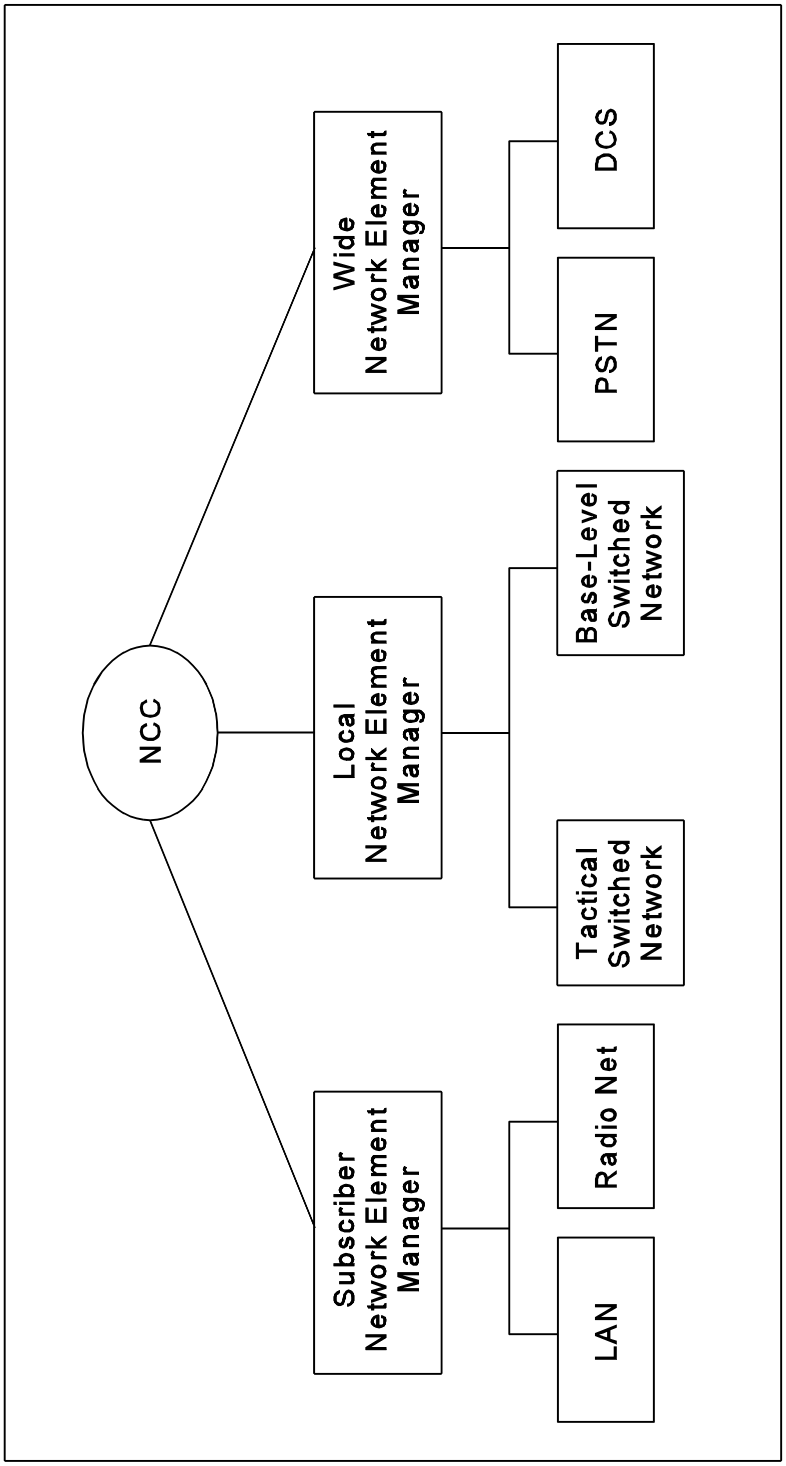


FIGURE 19. Typical intrabase, distributed, hierarchical network management architecture.

d. Performance management. Performance management functions shall provide the network manager with the ability to measure the quality and effectiveness of network communications and network components.

e. Security management. The network security manager shall be able to grant or restrict access to the entire network or selected critical parts of the network, such as the NM information base.

5.6.2.4 NM security. Security of the NM systems and information, and management of the security mechanisms that protect user traffic, shall be in accordance with MIL-HDBK-1351, the section titled *NM security*.

5.6.2.5 Military requirements for tactical systems. Tactical NM systems shall provide additional capabilities (such as conservation of bandwidth, precedence, mobility, and survivability), as defined in MIL-HDBK-1351, the section titled *Military requirements for tactical systems*.

5.7 Performance standards. Terminal-to-terminal performance standards, applied to hypothetical reference circuits (HRC), are included in this MIL-STD to provide system designers and planners with a consistent basis for establishing system parameters.

5.7.1 Hypothetical reference circuits. An HRC has a specified configuration and length. It is based on such factors as communications requirements, user satisfaction, equipment performance, installation and operation procedures, and experience. Reference circuit configurations, such as the number of links, trunks, and nodes, in tandem with associated transmission equipment, are chosen so that each configuration can be considered representative of a typical network or subsystem operational circuit. The nominal length of a reference circuit normally represents the probable maximum distance over which communications are required in the network or subsystem under consideration.

An HRC is used (a) as a reference for the performance of planned or operational circuits; (b) as guidance for planning and engineering circuits and networks; (c) as a means of pro-rating and allocating transmission parameters to different portions of a circuit and associated equipment; and (d) as a basis to derive interface, subsystem, and equipment standards.

Normally, in an operational communications system, various circuits with different lengths and parameters from the HRCs are employed. It is not practical to standardize the performance of every link or circuit that may have to be engineered and installed. The purpose of standardizing performance end-to-end (and defining HRCs) is to ensure that actual links, trunks, and circuits will perform satisfactorily as parts of an overall subsystem or system.

Designers and circuit engineers are expected to make their own assumptions and decide on such factors as length of radio links; channel perturbations, such as noise and jitter; number of PCM, ADPCM, and CVSD tandem links; number of A/D conversions; and delay characteristics to optimize circuit performance.

5.7.2 Hypothetical reference connections. The HRCs described in 5.7.2.1 and 5.7.2.2 can also be viewed as hypothetical reference connections (HRX) for circuit-switched calls or packet-switched calls. End-to-end performance parameters given in 5.7.2.2 and 5.7.3 apply only to circuit-switched calls. End-to-end performance parameters for packet-switched calls are a subject for further study.

5.7.2.1 Wide-network segments. The segments that constitute each HRC are summarized in Table XIII.

TABLE XIII. Reference segments for wide-network segments.

REFERENCE SEGMENT	**DESCRIPTION**
Tail	Same as 320-km terrestrial segment
320-km terrestrial segment	Eight line-of-sight (LOS) radio repeater links
Satellite or transoceanic submarine cable	One satellite link with a 40-km LOS radio link at one end, and a metallic or fiber optic cable connection at the other end

5.7.2.2 Error-free-second ratio allocation. The error-free-second (EFS) ratio allocation for each segment and the resulting performance for each HRC is provided in Table XIV.

TABLE XIV. Error-free-second ratio allocation.

SEGMENT	**PER SEGMENT**	**HRC**		
		GLOBAL	**OVERSEAS**	**INTRA-CONTINENTAL**
Tail	0.9996	---	---	---
320-km terrestrial segment	0.9995	---	---	---
Satellite or transoceanic cable	0.9997	0.9936 ---	N/A ---	0.9968 ---
HRC	---	0.9916	0.9936	0.9949

5.7.3 Wide networks. Three HRCs for wide networks exist. They are illustrated in Figure 20. The parameter selected to characterize error performance in wide networks shall be the EFS ratio for a 64-kbps channel. The terminal-equipment to terminal-equipment performance requirement for the EFS ratio is 0.99 for a circuit traversing each HRC, as shown in Figure 20.

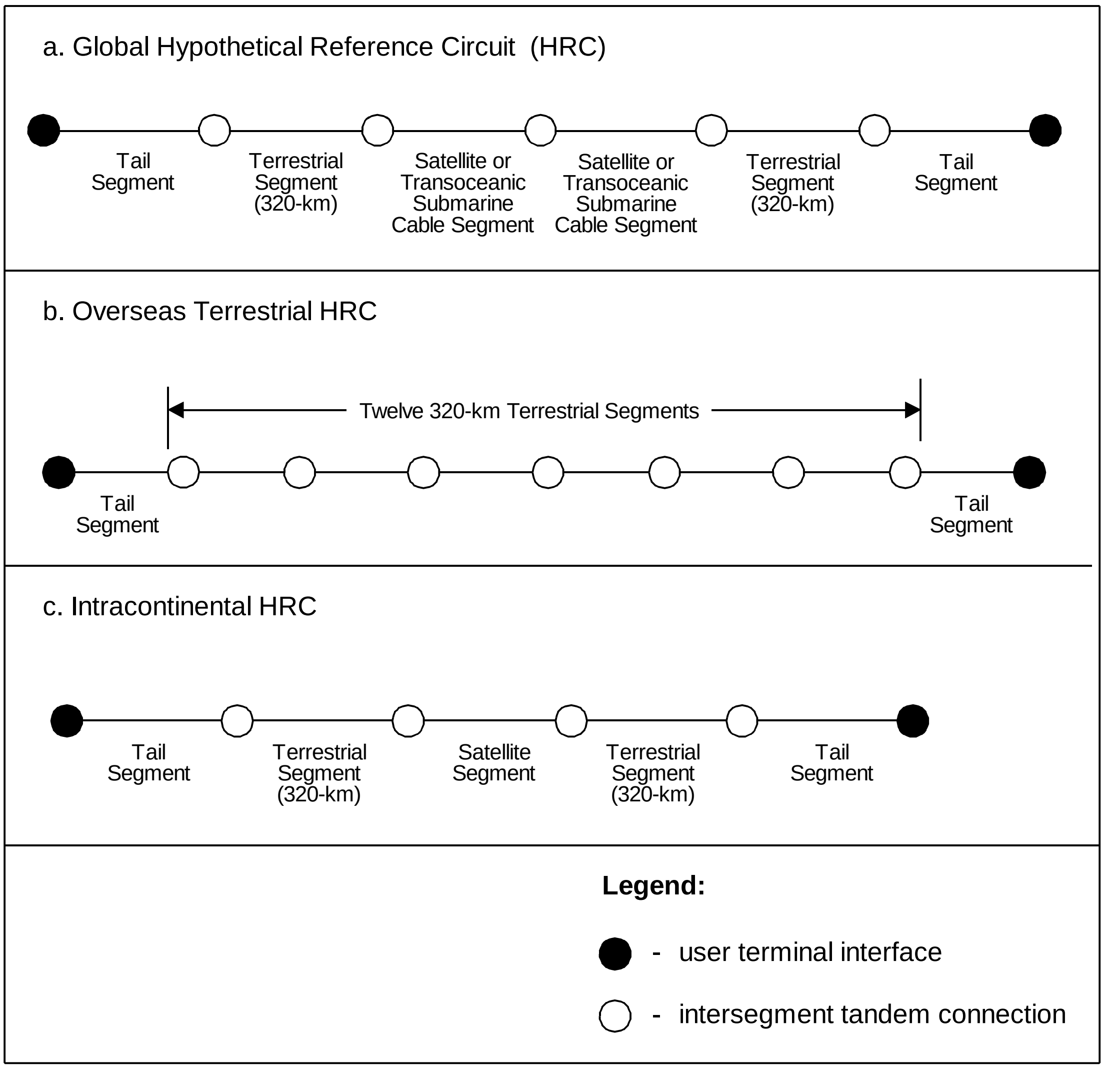


FIGURE 20. HRCs for wide networks.

5.7.4 Tactical networks. Three HRCs exist for U.S. tactical circuits:

a. The first HRC, shown in Figure 21, consists of six internodal line-of-sight (LOS) radio links in tandem. Each internodal LOS radio has a maximum planning distance of 50 km with an 8-km down-the-hill (DTH) millimeter wave or cable link on each end.

b. The second HRC, shown in Figure 22, consists of one internodal troposcatter link covering a transmission distance of 200 km in tandem with 2 internodal LOS radio links of 50 km each. Each troposcatter and LOS radio link has an 8-km DTH millimeter wave radio or cable link on each end.

c. The third HRC, shown in Figure 23, consists of two tactical subnetworks interconnected by wide-network elements, as provided by the DCS or public switched telephone networks (PSTN). In this case the information transmits up to 12 LOS radio links and 24 DTH links.

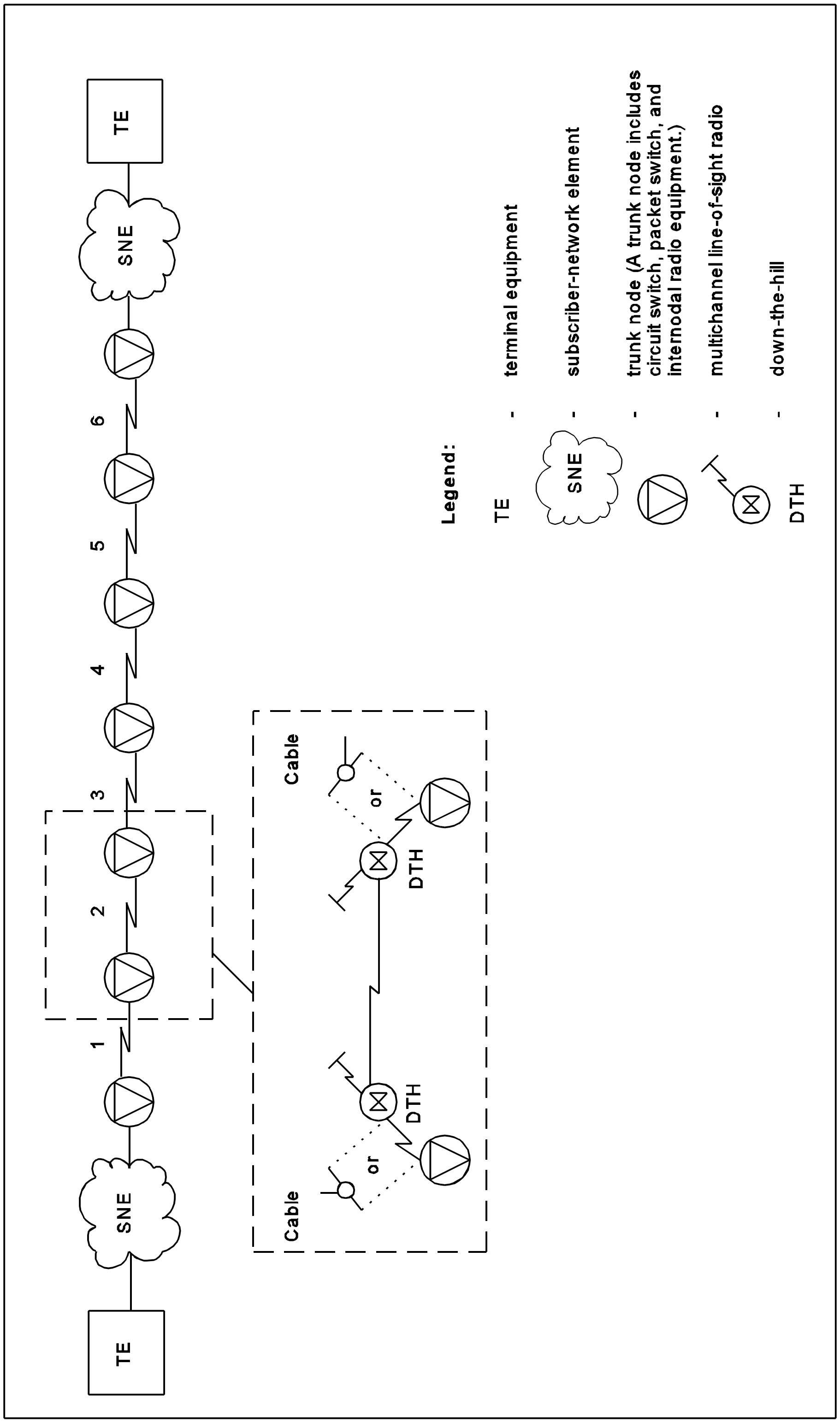


FIGURE 21. HRC for tactical networks based on LOS and tropo radio links.

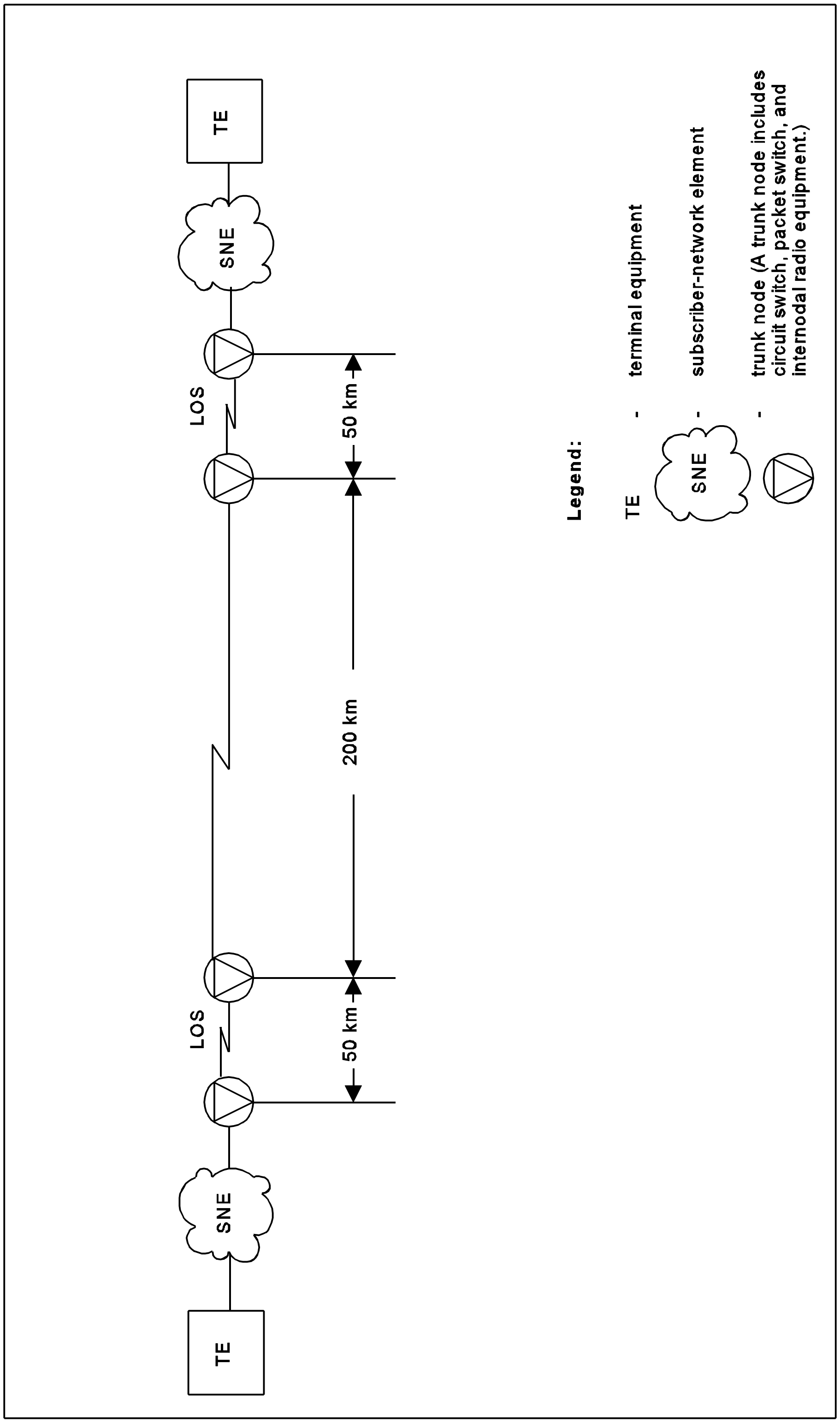


FIGURE 22. HRC for tactical networks based on LOS radio links.

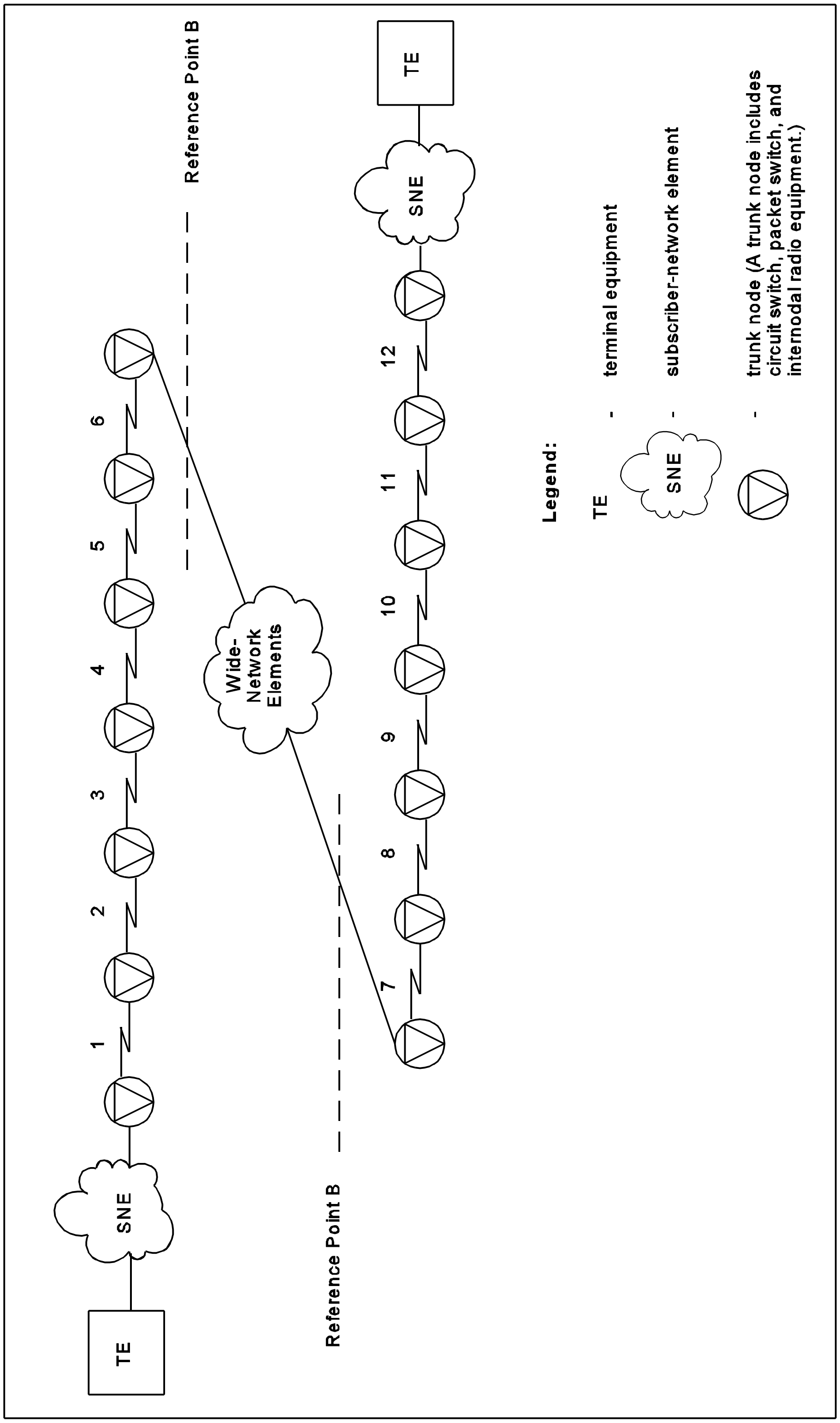


FIGURE 23. HRC for tactical networks interconnected by wide-network elements.

The contribution to the overall circuit error ratio allocated to tactical network elements is provided in Table XV.

TABLE XV. Operational bit error ratios for HRCs that use tactical-network elements.

TYPE OF SECTION	CONTRIBUTION PER CIRCUIT	
	BIT ERROR RATIO (BER)	% OF ANY MINUTE
LOS radio	1×10^{-4}	99.0
Tropo radio	4×10^{-4}	99.0
DTH radio	1×10^{-5}	99.0
DTH coaxial cable	1×10^{-6}	99.9
DTH fiber optic cable	1×10^{-8}	99.9

NOTE: The operational error rates are transmission errors and do not include effects of error correction or encryption devices.

5.7.5 Subscriber networks. Subscriber terminal equipment is connected to the local base-level or tactical network via subscriber network elements. Four HRCs applicable to subscriber networks exist. The first two are applicable to both strategic and tactical users. The third and fourth are applicable to tactical users only.

a. A direct metallic cable connection between the subscriber's terminal equipment and the local circuit or packet switch. The cable may be up to 4 km long.

b. A LAN complying with LAN standards ISO 8802-3, 8802-4, or 8802-5.

c. A radio network composed of combat net radios.

d. A mobile subscriber radio terminal (MSRT).

The contributions to the overall circuit BER allocated to subscriber-network elements is provided in Table XVI.

TABLE XVI. Operational error rates for HRCs that use subscriber-network elements.

TYPE OF SECTION	**CONTRIBUTION PER CIRCUIT**	
	BIT ERROR RATIO (BER)	**% OF ANY MINUTE**
Metallic cable connection	1×10^{-6}	99.9
Local area network	TBD	TBD
Radio network	4×10^{-3}	95.0
Mobile subscriber radio terminal	TBD	TBD
DTH fiber optic cable	1×10^{-8}	99.9

5.8 Numbering plans. A standard numbering plan format shall be employed on all trunks that cross reference-point B. This includes all joint and international circuit- and packet-switched trunks.

5.8.1 Circuit-switched trunks. Telephone numbers, as they appear on joint circuit-switched trunk interfaces, shall consist of a 3-digit area code and a 7-digit subscriber number unique to each area code. Telephone numbers for international calls shall consist of a nationality identifier (NI), in addition to the area code and the subscriber number.

5.8.1.1 Nationality identifier. The NI for calls between U.S. tactical users and NATO tactical users, reference point B (NATO), shall comply with STANAG 4214. The NI is of the form 9CC, where CC is the 2-digit country code used to identify the nationality of the called formation. The NI for calls between U.S. strategic users and other nations' strategic users shall also comply with STANAG 4214.

5.8.1.2 Area codes. The area codes for calls between U.S. tactical users and NATO tactical users shall comply with STANAG 4214 and shall be of the form NCC, where N = 0, 1, ..., 8 and CC is the 2-digit country code used to identify the nationality of the major formation associated with the called formation. Area codes for calls between U.S. joint tactical networks shall comply with CJCSM 6231.02, the chapter titled *Numbering Systems and Plans and Routing*. Area codes for base-level and wide-network elements shall comply with DCAC 370-175-13, the section titled *DSN Worldwide Numbering and Dialing Plan*.

5.8.1.3 Subscriber telephone numbers. The standard telephone number, as it appears at joint and combined trunk interfaces, shall have 7 digits. The 7 digits consist of 2 subcomponents: a 3- or 4-digit switch code, and a 4- or 3-digit subscriber number. Systems that employ deducible directories, automatic subscriber affiliation, and flood-search routing shall use all 7 digits as the unique subscriber number.

5.8.2 Packet-switched trunks. The address of the called terminal shall be provided in the call request packet, in accordance with ITU-T X.31. As an objective, DoD will evolve toward an integrated addressing plan applicable to both circuit-switched and packet-switched trunking. In the interim, packet-switched network elements shall comply with standards adopted for IP router networks. See 5.2.2.2.1.1.

5.8.3 Digit capacity for international systems. The number length for international calls may be increased to accommodate future network requirements (see ITU-T E.163, the section titled *Digit capacity of international registers*, and E.164, the section titled *Number length*). The digit capacity of registers required to process international calls should provide a minimum capacity of 15 digits. This digit capacity does not include all digits dialed by telephone subscribers, such as access and priority digits.

5.8.4 Subaddressing (network address extension). The 7-digit subscriber number shall identify connections at reference point A. Additional subaddressing required to identify subscriber-to-network terminations or service access points shall be transparent to the local- and wide-network elements. For base-level subscribers, up to 40 digits may follow the subscriber number, as illustrated in ITU-T E.164, the section titled *Address information*.

5.9 National Imagery Transmission Format Standard. The National Imagery Transmission Format (NITF) Standard (NITFS) defines the standard formats for digital imagery and imagery-related products that are to be exchanged between members of the Intelligence Community, DoD, and other departments and agencies of the United States Government. The NITFS includes supporting standards for imagery, image compression, other imagery-related requirements, and the Tactical Communications 2 (TAC02) protocol. The document structure for current and anticipated NITFS documentation is described in MIL-HDBK-1300). DoD has developed imagery-related standards for the NITFS suite: MIL-STD-2500, MIL-STD-2301, MIL-STD-188-196, MIL-STD-188-197, and MIL-STD-188-198. The NITFS suite includes MIL-STD-2045-44500, which defines a standard format for transmitting digital imagery information over tactical communications circuits.

5.9.1 MIL-STD-2500. The format for the NITF Standards provides a detailed description of the overall structure of the file format, as well as specification of the valid data content and format for all fields defined within a NITF file.

5.9.2 MIL-STD-2301. The Computer Graphics Metafile (CGM) Implementation Standard defines the subset of CGM commands applicable for graphic annotation of imagery within the NITFS.

5.9.3 MIL-STD-188-196. The Bi-Level Compression Standard defines the compression algorithm used for encoding bi-level image and overlay information used for transmission of one-bit-per-pixel imagery.

5.9.4 MIL-STD-188-197. The Adaptive Recursive Interpolated Differential Pulse-Code Modulation (ARIDPCM) Standard defines a compression for 8- and 11-bit gray-scale imagery used in conjunction with NITF version 1.1.

5.9.5 MIL-STD-188-198. The Joint Photographic Experts Group (JPEG) Standard defines compression of 8- and 12-bit gray-scale and 24-bit color image data used in conjunction with NITF version 2.0.

5.9.6 MIL-STD-188-199. The Vector Quantization Decompression standard defines the decompression of data which uses the vector quantization compression algorithm.

5.9.7 MIL-STD-2045-44500. Tactical Communications Protocol 2 (TAC02) defines a communications protocol and error correction methods used to exchange NITFS messages across a wide variety of tactical communications circuits.

5.10 Satellite communications. The standards for satellite communications (SATCOM) can be categorized in accordance with the frequency band of operation, that is, UHF, SHF, and EHF. Joint efforts between NASA and DoD are ongoing to develop upper-layer communications protocols for use in the space environment.

5.10.1 UHF SATCOM standards. The standards for UHF SATCOM are described in 5.10.1.1 to 5.10.1.5.

5.10.1.1 MIL-STD-188-181. The parameters defined in MIL-STD-188-181 provide for the interoperability and performance of UHF SATCOM terminals that use nonprocessed 5-kHz (narrowband) and 25-kHz (wideband) channels. The waveform is for use in the dedicated/phase-shift keying (PSK) mode for narrowband channels and the dedicated/frequency-shift keying (FSK)/PSK mode for wideband channels.

5.10.1.2 MIL-STD-188-182. The parameters defined in MIL-STD-188-182 provide for the dynamic sharing of one or more nonprocessed narrowband UHF SATCOM channels in the dedicated/shaped offset quadrature phase-shift keying (SOQPSK) or demand assignment multiple access (DAMA)/SOQPSK mode, among numerous users.

5.10.1.3 MIL-STD-188-183. The parameters defined in MIL-STD-188-183 provide for the dynamic sharing of a nonprocessed wideband UHF SATCOM channel in either the TDMA/binary phase-shift keying (BPSK)/differentially encoded quadrature phase-shift keying (DEQPSK) or DAMA/BPSK/DEQPSK mode, among numerous users.

5.10.1.4 MIL-STD-188-184. The parameters defined in MIL-STD-188-184 provide for data compression and adaptive error-correction processing of user data.

5.10.1.5 MIL-STD-188-185. The parameters defined in MIL-STD-188-185 provide for centralized control and decentralized management of 5-kHz and 25-kHz UHF military satellite communications (MILSATCOM) resources.

5.10.2 SHF SATCOM standards. The standards for SHF SATCOM are described in 5.10.2.1 to 5.10.2.6.

5.10.2.1 MIL-STD-188-164. MIL-STD-188-164 defines minimum mandatory RF and IF requirements to ensure interoperability of SATCOM earth terminals operating over C-band, X-band, and Ku-band channels.

5.10.2.2 MIL-STD-188-165. MIL-STD-188-165 defines minimum mandatory requirements to ensure interoperability of PSK modems operating in the FDMA mode with SHF SATCOM earth terminals.

5.10.2.3 MIL-STD-188-166. MIL-STD-188-166 will define the communications link characteristics required to control and manage the access to SHF SATCOM transponders.

5.10.2.4 MIL-STD-188-167. MIL-STD-188-167 will define the communications protocols required for the assignment of SHF satellite space resources in accordance with demand.

5.10.2.5 MIL-STD-188-168. MIL-STD-188-168 will define the formats, protocols, and other communications techniques required for transferring multiple-user information over a single SATCOM link.

5.10.2.6 MIL-STD-188-169. MIL-STD-188-169 will define the minimum mandatory RF requirements to ensure interoperability of SATCOM earth terminals operating over leased satellite transponders operating in C- and Ku-bands.

5.10.3 EHF SATCOM standards. The standards for EHF SATCOM are described in 5.10.3.1 and 5.10.3.2.

5.10.3.1 MIL-STD-1582. MIL-STD-1582 defines a common waveform for low-data-rate (75 to 2400 bps) EHF satellite data links.

5.10.3.2 MIL-STD-188-136. MIL-STD-188-136 will define a common waveform for medium-data-rate (up to 1.544 Mbps) EHF satellite data links.

5.10.4 MIL-STD-2045-14500 series. MIL-STD-2045-14500 Series will define the upper-layer SATCOM protocols for use in the space environment. This involves space-to-ground and space-to-space link. The protocols are being developed in these areas: file transfer, transpack security, and networking. The series of MIL-STD-2045-14500 will address unique constraints of the space environment such as effects of limited bandwidth; limited processing and memory capability; dynamically changing network parameters; and high BER.

5.11 Meteor burst communications. Meteor burst radio communications relies on the billions of meteors that enter the earth's atmosphere daily, that are vaporized by atmospheric friction, and that produce ionized trails. A high percentage of these trails lasts less than one-half second, although some trails last up to several seconds. Trail occurrence and duration are random events. Three proposed federal standards (FED-STD) are intended for use by systems that use meteor burst communications: FED-STD-1055, FED-STD-1056, and FED-STD-1057.

5.11.1 FED-STD-1055. Half-duplex operation between conventional master and conventional remote meteor burst communications stations shall comply with the interoperability parameters provided in FED-STD-1055. Major interoperability parameters are listed below.

a.	Frequency range:	40 to 50 MHz (minimum)
b.	Frequency accuracy:	3 ppm for master stations 5 ppm for remote stations
c.	Modulation:	Differentially-encoded BPSK Binary 0 = 0° phase change Binary 1 = 180° phase change
d.	Data rates:	4 and 8 kbps ± .01%
e.	Error control:	16-bit CRC check sum, code generator polynomial $g(x) = x^{16} + x^{15} + x^{2} + 1$

f. Link-level operation: See FED-STD-1055, the sections titled *Link Level Operation for Bi-directional Communications* and *Broadcast Link Level Operation*

5.11.2 FED-STD-1056. The method used for encrypting the text of messages between meteor burst communications stations shall comply with FED-STD-1056. (NOTE: FED-STD-1056 does not restrict the use of other encryption devices capable of providing cryptographic compatibility with FED-STD-1055 and FED-STD-1057, such as the KG-84.)

5.11.3 FED-STD-1057. Full-duplex operation between conventional master stations in different meteor burst communications networks shall comply with the interoperability parameters provided in FED-STD-1057. Major interoperability parameters are listed below.

a. Frequency range: 40 to 50 MHz (minimum)

b. Frequency accuracy: 3 ppm

c. Modulation: Differentially-encoded BPSK
Binary 0 = 0° phase change
Binary 1 = 180° phase change

d. Data rates: 8 kbps ± .01%

e. Error control: 16-bit CRC check sum, code generator polynomial $g(x) = x^{16} + x^{15} + x^2 + 1$

f. Link-level operation: See FED-STD-1057, the section titled *Link Level Operation*

5.12 Digital message transfer devices. A digital message transfer device (DMTD) is a portable data terminal device with limited message generation and processing capability. DMTDs are used for remote access to automated C4I systems and to other DMTDs. The environment encompasses point-to-point, point-to-multipoint, and broadcast transfer of information over combat radio networks. New DMTDs shall comply with the communications protocols, parameters, and procedures defined in MIL-STD-2045-14502-1, MIL-STD-2045-14502-6, and MIL-STD-2045-47001.

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6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but it is not mandatory.)

6.1 Key-word listing. The following key words, phrases, and acronyms apply to MIL-STD-187-700:

- asynchronous transfer mode (ATM)
- broadband ISDN (B-ISDN)
- circuit-switched networks (CSN)
- Data Communications Protocol Standards (DCPS)
- Defense Data Network (DDN)
- Digital Subscriber Signaling System Number 1 (DSS1)
- DoD Standardized Profiles (DSP)
- hypothetical reference circuits (HRC)
- Integrated Services Digital Network (ISDN)
- Internet
- IP Routers
- local-area networks (LAN)
- Multi-level Precedence and Preemption (MLPP)
- Message-Handling System (MHS)
- Military Messaging System (MMS)
- networking
- network management (NM)
- packet-switched network (PSN)
- personal communications services (PCS)
- Profiles for Open Systems Internetworking Technologies (POSIT)
- Synchronous Digital Hierarchy
- Synchronous Optical Network (SONET)
- Signaling System Number 7 (SS7)
- tactical-to-strategic interface
- wide-area network (WAN)

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CONCLUDING MATERIAL

Custodians:

Army - CR

Navy - EC

Air Force - 90

Preparing activity:

DISA (JIEO) - DC

(Project TCSS-7002)

Review activities:

Army - SC

Navy - MC, SH, AS

Air Force - 02, 13, 17, 18, 19, 93

NSA - NS

OASD - IR

DMA - MP

DIA - DI

DLA - DH

ECAC

Civilian agency coordinating activities:

NCS

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DSN No. 7, Common Channel Signaling

A.1. Scope. This Appendix is a mandatory part of this standard. The information contained herein is intended for compliance. This appendix specifies Defense Switched Network (DSN) No. 7 Common Channel Signaling.

A.2. Applicable documents. Applicable documents for this appendix are listed in section 2 of the basic standard.

A.3. Definitions. Definitions for this appendix are listed in section 3 of the basic standard.

A.4. General information on DSN No. 7. The following DSN No. 7 specification is contained in paragraph 7.8 of the Defense Switched Network (DSN) Generic Switching Center Requirements (GSCR). The paragraph numbers and format from the GSCR have been retained for ease of use.

7.8 Common Channel Signaling-DSN No.7 CCS

7.8.1 ANSI T1.110.1 - Overview of the Signaling System. The DSN No.7 CCS conforms to the Signaling System Number 7 (SS7) overview provided in ANSI T1.110, Chapter 1. An overview of DSN specific requirements is provided in the following paragraphs, citing the applicable paragraphs of the standard, e.g., 1.0.

a. 1.0 Introduction. The DSN No.7 CCS network shall be compatible with the national signaling networks based on the ANSI T1.100 series of standards and shall be capable of interworking with networks based on SS7, as standardized internationally in the Blue Book (1988) by the International Telephone and Telegraph Consultative Committee (CCITT) (i.e., CCITT SS7).

The DSN No.7 CCS consists of the following American National Standard Institute (ANSI) communications protocols: (1) Message Transfer Part (MTP), (2) Signaling Connection Control Part (SCCP), (3) ISDN-User Part (ISDN-UP), (4) Transaction Capability Application Part (TCAP), (5) Monitoring and Measurements, and (6) Operation and Maintenance Application Part (OMAP). These protocols shall provide the capability necessary to meet DSN requirements for ISDN-based services, circuit-switched call control, and signaling network management.

b. 2.0 Scope, Purpose and Application.

(1) 2.1 Objectives and Fields of Application.

(a) Objectives. The objectives of the CCS No.7 implementation in DSN go beyond basic circuit-switched call control signaling. DSN No.7 CCS emphasizes supporting ISDN advanced capabilities. This support directly applies to the DSN management, administration, and operation applications, and lays the groundwork for the present and future requirements for information transfer in DSN. The general objective of DSN No.7 CCS system is to provide standardization of CCS No.7 system in the DSN.

The DSN-specific objective is to provide the universal signaling protocol for use throughout the entire DSN; Signaling Gateways within the DSN network between the major geographical areas will not be required.

It is anticipated that interconnections will be made with both public and military networks in the DSN host countries. Signaling Gateways may be required between the DSN and these interconnecting areas. These interface requirements shall be based on the DSN No.7 CCS protocol, DSN User-Network Signaling Protocol, and the DSN Interface Criteria.

(b) Applications. In general, the DSN No.7 CCS system meets DSN requirements for call control signaling of telecommunication services (such as telephone and circuit-switched data transmission services). It can also provide a reliable transport system for information transfer between exchanges and specialized centers in the DSN (e.g., for management and maintenance).

The system is optimized for operation over 64 kilobits per second (kb/s) digital channels and is suitable for use on point-to-point and point-to-multipoint terrestrial and satellite links. The DSN No.7 CCS system is intended to be implemented with components developed in commercial applications that follow the ANSI standards for CCS No.7. Specifically, DSN No.7 CCS applies the necessary protocols applicable to services essential for DSN, such as Multi-Level Precedence and Preemption (MLPP), Conferencing (i.e., Preset), Community of Interest, Management, and transfer of data different from signaling data.

(2) 2.2 General Characteristics. Critical characteristics for the DSN are operability and reliability. The DSN No.7 CCS standardizes a number of features contributing to high operability and reliability, such as decentralized distributed architecture, uniform management protocol, error

detection and correction, redundancy of signaling links and nodes, and diversion of signaling traffic to alternative paths.

(3) 2.3 Modularity. DSN No.7 CCS is a subset of the modular structure of CCITT SS7. The following specifications represent the set of features standardized for DSN No.7 CCS in the DSN. They are derived from the ANSI standards for the U.S. SS7 system, which is one of a set of national standards based on CCITT. The CCITT SS7 includes a wide range of functions, of which the ANSI SS7 is a subset. The DSN No.7 CCS includes the ANSI SS7 features and extends to meet specific DSN requirements.

c. 3.0 Signaling System Structure.

(1) 3.1 Basic Functional Division. The basic composition of functional blocks applicable to DSN No.7 CCS consists of the ANSI specified protocols, a subset of the functional blocks (protocols) found in the CCITT Blue Book (Q.700 series). These blocks are: MTP, ISDN-UP, SCCP, TCAP, OMAP, and Monitoring and Measurements. The fundamental principle of this structure is the division of the functions into the MTP and SCCP, which serve as transport systems for transfer of signaling messages, and the user parts--ISDN-UP, TCAP, OMAP and Monitoring and Measurements--which directly or indirectly utilize the capabilities provided by the MTP.

(2) 3.2 Functional Levels. The protocol needed for DSN No.7 CCS is compatible with the model specified by the ANSI T1.110 standard, and can be related to the seven-layer Open System Interconnect (OSI) Reference Model (RM), as described in the above standard.

d. 4.0 DSN No.7 CCS Specification Guide.

(1) 4.1 Support Information. The DSN No.7 CCS specifications are based on Issue 1 of ANSI SS7 Standards finalized in 1987 and 1988, plus the revisions being developed for Issue 2. The specifications are subdivided as shown in the following paragraphs. Each specification fully incorporates the applicable standard, except where explicitly noted in the subsections of the applicable specification. In these subsections, particular options, procedures, or parameters specific to the DSN are specified.

(2) 4.2 Message Transfer Part (MTP). The MTP of the DSN No.7 CCS shall be as specified in Section 7.8.2. The MTP Specification is subdivided into the following subsections, which correlate to chapters in ANSI T1.111: (1) 7.8.2.1, ANSI T1.111.1- Functional Description of the Signaling System Message

Transfer Part (MTP); (2) 7.8.2.2, ANSI T1.111.2-Signaling Data Link; (3) 7.8.2.3, ANSI T1.111.3-Signaling Link (MTP); (4) 7.8.2.4, ANSI T1.111.4-Signaling Network Functions and Messages (MTP); (5) 7.8.2.5, ANSI T1.111.5-DSN Signaling Network Structure (MTP); (6) 7.8.2.6, ANSI T1.111.6-DSN Message Transfer Part Signaling Performance (MTP); (7) 7.8.2.7, ANSI T1.111.7-DSN Testing and Maintenance (MTP); and (8) 7.8.2.8 ANSI T1.111.8-Numbering of Signaling Point Codes (MTP).

(3) 4.3 Signaling Connection Control Part (SCCP). The SCCP of the DSN No.7 CCS shall be as specified in Section 7.8.3. The SCCP Specification is subdivided into the following subsections, which correlate to chapters in ANSI T1.112: (1) 7.8.3.1, ANSI T1.112.1-Functional Description Of The Signaling Connection Control Part (SCCP); (2) 7.8.3.2, ANSI T1.112.2-Definition and Function of SCCP Messages (SCCP); (3) 7.8.3.3, ANSI T1.112.3-SCCP Format and Codes (SCCP); and (4) 7.8.3.4, ANSI T1.112.4-Signaling Connection Control Part Procedures (SCCP).

(4) 4.4 Integrated Services Digital Network (ISDN) User Part (UP). The ISDN-UP of the DSN No.7 CCS shall be as specified in Section 7.8.4. The ISDN-UP Specification is subdivided into the following subsections, which correlate to chapters in ANSI T1.113: (1) 7.8.4.1, ANSI T1.113.1-Functional Description of ISDN User Part (ISDN-UP); (2) 7.8.4.2, ANSI T1.113.2-General Function Of Messages and Signals; (3) 7.8.4.3, ANSI T1.113.3-Formats and Codes; (4) 7.8.4.4, ANSI T1.113.4-Signaling Procedures; and (5) 7.8.4.5, ANSI T1.113.5-Performance Objectives In The ISDN Application.

(5) 4.5 Transaction Capabilities Application Part (TCAP). The TCAP of the DSN No.7 CCS shall be as specified in Section 7.8.5. The TCAP Specification is subdivided into the following subsections, which correlate to chapters in ANSI T1.114: (1) 7.8.5.1, ANSI T1.114.1-Functional Description and Transaction Capabilities (TCAP); (2) 7.8.5.2, ANSI T1.114.2-Definition and Function Of Transaction Capabilities Messages (TCAP); (3) 7.8.5.3, ANSI T1.114.3-TC Format and Codes (TCAP); and (4) 7.8.5.4, ANSI T1.114.4-Transaction Capability Procedure (TCAP).

(6) 4.6 DSN No.7 System Management. The DSN No.7 CCS Monitoring and Measurements shall be as specified in Section 7.8.6.1, ANSI T1.115-Monitoring and Measurements of SS7. The DSN No.7 CCS Operations, Maintenance and Administration Part (OMAP) shall be as specified in Section 7.8.6.2, ANSI T1.116-Operations, Maintenance and Administration Part (OMAP).

7.8.2 DSN No.7 CCS Message Transfer Part (MTP). The DSN No.7 CCS Message Transfer Part (MTP) shall be as specified in ANSI T1.111-1988, Chapters 1-8. Specific requirements for DSN application are given in the following subsections.

7.8.2.1 ANSI T1.111.1-Functional Description of the Signaling System Message Transfer Part (MTP). The Functional Description of the DSN No.7 CCS Message Transfer Part (MTP) shall be as specified in ANSI T1.111.1. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Signaling System Structure.

(1) 2.2 Functional Levels.

(a) 2.2.2 Signaling Data Link Functions (Level 1). The Signaling Data Link is a bidirectional digital transmission path comprised of digital signaling links. A maximum of 72 Digital Signaling Links* shall be supported at an individual DSN Signaling Point (SP). Because of its worldwide scope, the DSN No.7 shall support both terrestrial and satellite transmission for the Signaling Data Links at bit rates of 56 or 64 kb/s. These functions are specified in detail in ANSI T1.111.2.

* Note: A future expansion on the number of signaling links supported by a DSN SP is not prevented by this specification.

(b) 2.2.3 Signaling Link Functions (Level 2). The DSN Signaling Link Functions apply to both terrestrial and satellite transmission. These shall require the implementation of both types of error correction methods specified in Signaling System No.7: the Basic Error Correction method for use on terrestrial Signaling Data Links and the Preventive Cyclic Retransmission method for use on Satellite Signaling Data Links. Detailed requirements are specified in ANSI T1.111.3.

(c) 2.2.4 Signaling Network Functions (Level 3). The DSN Signaling Network Functions include the Signaling Message Handling and Signaling Network Management requirements. The DSN network architecture imposes special requirements on the routing, addressing, and management of the CCS network. A detailed specification of signaling network functions is found in T1.111.4. Network testing information is found in T1.111.7.

b. 3.0 Signaling Network.

(1) 3.1 DSN Basic Concepts and Features.

(a) 3.1.2 Signaling Modes. The DSN Network structure is based on an associated architecture with decentralized STP capability. The signaling network replicates the connectivity of the switched network it serves. Each trunk group in the network is assigned one associated signaling channel. The associated mode of signaling is thus the first choice to establish a signaling relation between adjacent signaling points. The decentralized STP capability provides quasi-associated signaling as a backup to the associated signaling link in case of link failure or other unavailability, or as a second choice to establish adjacent signaling point signaling relations. Signaling relations between non-adjacent signaling points may be established by the Signaling Connection Control Part (SCCP).

One Signaling Data Link is required between any two adjacent signaling points. Backup to this signaling link is provided by utilizing a quasi-associated route until a new direct link is available. When a path for associated signaling fails, a procedure is started to restore the path by activating and switching into service a new circuit to perform as a Signaling Data Link. This concept results in an associated signaling network architecture with quasi-associated capability.

(b) 3.1.3 Signaling Point Modes. The common channel signaling equipment associated with each DSN nodal switch shall provide the functions of a Signaling Point (SP) and Signaling Transfer Point (STP), unless specifically noted otherwise. This is designated as a DSN SP/STP node. The DSN nodes, which do not include the STP function, are designated as DSN SP nodes. A DSN SP/STP node has the ability to originate signaling messages, to receive signaling messages from an origination signaling point (node), and to transfer signaling messages destined for another signaling point node. A DSN SP node without the STP capability can originate and receive signaling messages only. Messages destined to other signaling points are never routed through a DSN SP-only node.

(c) 3.1.4 Message Labeling. The North American Routing Label, which is utilized in the DSN, is optimized for use with a quasi-associated, paired STP network architecture different from the DSN architecture. Section 7.8.2.4 specifies how the routing label is to be used in the DSN Network.

(2) 3.2 Signaling Message Handling Functions.

(a) <u>3.2.1 Message Routing</u>. Message routing is based on analysis of the routing label of the message in respect to predetermined routing data at a signaling point. This process provides a selection of succession of signaling links for each message-"message route" and/or succession of link sets-"signaling route." Each signaling message route in the DSN is predetermined and fixed at a given point in time. A message routed toward a specific destination in the DSN is always based on the associated signaling links. If the associated link is not available, quasi-associated routing is used based upon a predetermined selection of signaling links that support the first alternate trunk route. This selection proceeds through the remaining predetermined alternate circuit routes until an available supporting link is found.

DSN routing includes load sharing capability, allowing different portions of the signaling traffic sent to a particular destination to be distributed over two or more signaling links in a link set.

A service indicator included in each message provides the potential to use different routing plans for different user parts.

(b) <u>3.2.2 Message Distribution</u>. Message Distribution is required at all DSN signaling nodes.

(c) <u>3.2.3 Message Discrimination</u>. This function is not required at the DSN SP-only node.

(3) <u>3.3 Signaling Network Management Functions</u>.

(a) <u>3.3.2 Signaling Link Management</u>. In the DSN, where the signaling links are also routed through the circuit switched channels, signaling link management requires DSN-specific implementation guidance.

(b) <u>3.3.3 Signaling Route Management</u>. In the DSN this function is used for backup signaling and in cases where the primary associated signaling routes may present difficulties. Implementation of this function in the DSN No.7 CCS requires DSN-specific implementation guidance.

(4) <u>3.4 Testing and Maintenance Functions</u>. Testing and maintenance in the DSN environment is implementation-specific and requires DSN-specific implementation guidance.

(5) <u>3.5 Use of the Signaling Network</u>.

(a) 3.5.1 The DSN Signaling Network Structure. The DSN No.7 CCS system provision is planned to be based on associated signaling, supplemented by quasi-associated signaling. The DSN No.7 CCS is seen as a common resource that must meet DSN needs that go beyond each signaling relation. These needs will also require the DSN-specific implementation of quasi-associated signaling to allow the full potential of CCS No.7 to support the DSN communication needs.

(b) 3.5.2 Provision of Signaling Facilities. Redundancy is required within the DSN signaling network. The DSN-specific requirements are implementation dependent and shall be a part of the DSN No.7 CCS implementation guidance.

(c) 3.5.3 Application of Signaling Network Functions. These DSN No.7 CCS functions are a subset of the range of functions offered by the ANSI T1.111 standards. They will depend on the specific needs of the DSN subnetworks, which are spread over several geographical regions. The ANSI T1.111 standard provides for the DSN-preferred signaling modes, specific composition of SPs and STPs, and a degree of Level 3 use dictated by different implementations of DSN No.7 CCS.

7.8.2.2 ANSI T1.111.2-Signaling Data Link. The DSN No.7 CCS signaling data link shall be as specified in ANSI T1.111.2. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 1.0.

a. 1.0 General Information. The DSN No.7 CCS Signaling Data Link is derived from Pulse Code Modulation (PCM) multiplexed channels, circuit-switched transmission channels, and the digital streams of data circuits.

b. 4.0 Interface Specification Points.

(1) 4.2 National/International Applications. The DSN Signaling Data Link shall conform to ANSI T1.111.2. A Signaling Data Link located entirely in North America, shall utilize the North American transmission and equipment standards, and require no framing or Law conversions if interfaced with other U.S. networks. A Signaling Data Links required to interwork with the links specified by CCITT will require conversion to be fully compatible.

(2) 4.4 Interface Requirements-Analog. Analog signaling is not required in the DSN; therefore, no interface requirements are specified.

c. 5.0 Digital Signaling Data Link. The DSN Digital Signaling Data Link is derived from the 1.544 or 2.048 Mb/s digital path. The latter is the case when the CCITT specified signaling link is required.

The DSN Signaling Data Link is derived from one of the trunk group circuits serving each pair of switching nodes. Access to the link in the DSN implementation shall be provided through the switching matrix. Semi-permanent switched connections shall be utilized in establishing the data link access.

A digital signaling data link shall be made up of digital transmission channels and digital switches or their terminating equipment, providing an interface to signaling terminals.

Selection of Digital Time Slots to serve as signaling channels must be coordinated between both ends of the Signaling Data Link. The order for the selection of backup signaling channels must be similarly coordinated.

d. 6.0 Analog Signaling Data Link. Analog signaling is not required in the DSN.

7.8.2.3 ANSI T1.111.3-Signaling Link (MTP). The DSN No.7 CCS Signaling Link functions and procedures shall be as specified in ANSI T1.111.3. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard (e.g., 5.0).

a. 5.0 Basic Error Correction Method. The DSN shall use the Basic Error Correction Method on links composed entirely of terrestrial transmission media, unless the Preventive Cyclic Retransmission (PCR) method is used as described in paragraph "b" below.

b. 6.0 Error Correction by Preventive Cyclic Retransmission (PCR). The DSN shall use the PCR method when a satellite path is used in a combined link. In the DSN regions where a satellite path is used as an alternate route, the specification does not preclude the use of the PCR for all the links in the region, terrestrial and satellite.

7.8.2.4 ANSI T1.111.4-Signaling Network Functions and Messages (MTP). The DSN No.7 CCS signaling network functions and messages shall be as specified in ANSI T1.111.4. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard (e.g., 2.0).

APPENDIX A

a. <u>2.0 Signaling Message Handling</u>.

(1) <u>2.2 Routing Label</u>. The DSN uses the U.S. National Routing Label structure (specified in ANSI T1.111.4) for signaling messages between DSN SPs. The Routing Label shall also be used for routing signaling messages to other U.S. networks that comply with the ANSI SS7 Standard. The U.S. Routing Label is adapted for use in the DSN architecture according to the DSN Signaling Point Code Allocation Plan as specified in Section 7.8.2.8. The DSN Routing Label shall comply with the routing label structure for U.S. networks as shown in Figures 3A and 3B/T1.111.4.

The Network Cluster Member Subfield is assigned by the DSN Network Administrator to identify individual SP/STP as the DSN nodes. When used in this manner, the Cluster Member Subfield code 00000000 is reserved for addressing the DSN SP/STPs.

The Cluster Subfield may also be assigned to a selection of DSN SP nodes to be identified as a group. When utilized in this second manner, the Cluster Member Subfield may, for example, identify a cluster of DSN SP only nodes connected to a single DSN SP/STP or identify all signaling points in a particular geographic area or country. These particular instances of assignments do not limit the implementation of the DSN routing label in specific geographic regions.

The Signaling Link Selection (SLS) Field identifies the link set and individual signaling data link to be utilized as a message between two DSN signaling points. Use of the SLS Field in the DSN is affected by the DSN associated Network architecture and is specified in Section 7.8.2.5.

Interconnection between the DSN and non-U.S. signaling network may require use of the international routing label at the point of interconnection. The requirements for this use and the label translation shall be determined on a case-by-case basis as part of the interconnection agreement.

(2) <u>2.3 Message Routing Function</u>.

(a) <u>2.3.1 Signaling Link Selection</u>. The message routing function provides rules for selection of a signaling link for an outgoing message. In DSN No.7 CCS, an outgoing link is a part of combined link set that directly connects two DSN signaling nodes. The link set is determined by the Destination Point Code (DPC) in the message routing label; the particular link is determined on the basis of the Signaling Link Selection (SLS) field.

1. DSN Link Set. A link set in the DSN consists of a collection of signaling links that directly connect two DSN signaling nodes. The associated mode architecture of the DSN requires one signaling link set between any two directly-connected DSN switching center nodes. These DSN Link Sets are categorized at each signaling point as either a Normal Link Set, Current Link Set, or Alternative Link Set. Either a combined or a single link set is implemented between adjacent DSN signaling nodes.

2. Normal Link Set. The Normal Link Set provides the associated link that directly connects two adjacent DSN signaling nodes. This link set is assigned the highest priority and is always chosen by the routing functions when it is available.

3. Alternative Link Sets. Alternative Link Sets are utilized in the DSN to provide backup quasi-associated signaling capability when the associated signaling link (or a higher priority alternative link set) is unavailable. The priority assigned to the selection of alternative signaling links corresponds to the priority of the alternative routing selection in the circuit-switched network routing table. That is, the alternative signaling link set of the first alternative route for a circuit-switched call is assigned next in priority after the Normal Link set. This process of assignment continues until all Alternative Link Set priorities are assigned.

4. Current Link Set. The Current Link Set is the link set currently assigned to convey signaling messages to a particular destination signaling point. This link set should normally correspond to the current highest priority of link set availability.

5. DSN Signaling Links. The associated mode architecture of the DSN requires an active signaling data link between any two directly connected (adjacent) DSN switching center nodes. Backup is provided by inactive signaling data links, redundancy in signaling terminals, and switched access to other circuits normally used for other purposes (e.g., voice circuits). Automatic allocation of signaling terminals and signaling data links according to the Signaling Network Management procedures of ANSI T1.111.4 generally shall be provided.

(b) <u>2.3.3 Specifics of DSN Signaling Message Routing</u>. Each DSN SP/STP shall have routing tables that determine the Signaling Link Set and a Signaling Link to be used to convey signaling messages for each Destination Point Code. These tables shall indicate the Current Link Set in use to each DSN destination. Use of associated and quasi-associated signaling is mandated by procedures in the MTP that will provide a signaling relation to all signaling points in the network.

A key requirement is to simplify administration of the DSN SP/STP and DSN SP routing functions. The associated architecture of the DSN allows the signaling routing table to replicate the circuit- switched routing table. That is, for circuit-related calls, selection of an outgoing circuit is translated into selection of the current link set serving that destination point code. The signaling link set selected usually will correspond to the Normal (Associated) Link Set for that destination. When the Normal Link Set is unavailable, the indication is given of the highest Priority Alternative Link Set available.

Signaling for non-circuit-related purposes shall perform the same translation to the Current Link Set based upon the DPC.

A means shall be provided to reconfigure signaling routing changes in response to changes made to the circuit-switched call routing. Such reconfigurations may consist of the addition and deletion of routes, or changes to the priorities of alternate routes. These updates shall be in agreement with local coordination between the DSN Generic Switching Center and its common channel signaling equipment to ensure the transfer of circuit-switched and signaling routing information.

Agreement between the circuit-switched (call) routing and signaling routing tables does not require that the signaling data must follow the circuit-switched call route. This means that the signaling links associated with the adjacent switch's inter- exchange circuits are designated as part of the Normal Link Set (Highest Priority) for that destination. Alternate routes to that destination in the call routing plan are assigned to the Alternative Link Sets, which may be used for signaling to that destination according to their priority. The Current Link Set for signaling is chosen according to the availability of the Normal and the Alternative Link Sets. For example, a call may use a direct trunk circuit between two switches; however, a failure in the Normal Link Set may require use of quasi- associated signaling over an Alternative Link Set.

This procedure is intended to ensure that the prioritization of call routes and signaling routes is identical. The actual routes selected to serve the call and signaling may differ depending upon availability.

The following procedure is used to select a signaling route. As the DPC of the signaling message is determined, a circuit-related call destination is determined by the designation of the outgoing circuit. The DPC is translated into the link set available at the highest priority. An individual signaling link within the Current Link Set is chosen based on the SLS code.

(c) <u>2.3.5 Handling Messages Under Signaling Time Congestion</u>. Each message is assigned one of four levels of priority, from 0 (the lowest) to 3 (the highest level). Priorities are assigned by the message's generating user part and are taken into consideration by the congestion control to determine whether a message should be discarded under signaling link congestion conditions. The highest priority is assigned to signaling network management messages (priority 3). Priorities are assigned to categories of messages in the DSN; they could be dynamically reassigned under DSN-specific requirements. For example, the priority 2 assigned to the IAM with the precedence Flash and Flash Override and the priority 1 assigned to the IAM with the Immediate must be recognized under congestion conditions in the DSN and at the boundaries with other networks.

(3) <u>2.4 Message Discrimination and Distribution Functions</u>. The Message Discrimination function examines the Destination Point Code of a received signaling message to determine whether or not it is destined to the receiving SP. This function is required in every DSN signaling node equipped with an STP. Message Distribution determines to which user of the MTP a received signaling message will be directed. This function is also required in all DSN signaling nodes.

b. <u>3.0 Signaling Network Management</u>.

(1) <u>3.6 Signaling Network Congestion (and Priority Levels)</u>. Signaling links and signaling link sets determine the network overall operability during network element congestion. Criteria for the determination of DSN signaling congestion status shall be as specified by ANSI T1.111.4, Section 3.6 for U.S. networks. In case of congestion, IAMs carrying FLASH or FLASH OVERRIDE calls shall be assigned Level 2 and IMMEDIATE calls shall be assigned level 1 in the DSN.

c. <u>6.0 Changeback</u>.

(1) 6.3 Sequence Control Procedure. The Sequence Control Procedure is not used in the DSN.

(2) 6.4 Time-Controlled Diversion Procedure. DSN No.7 CCS uses the Time-Controlled Diversion procedure for changeover since specifics of the DSN No.7 CCS architecture permit communication with the remote signaling point via a signaling link that became available. As sending of the changeback declaration is impossible when changeback is initiated, the changeback initiating signaling point stops the traffic to be diverted and stores it in a "changeback buffer" for a time T3, then reopens the traffic on the signaling link made available.

d. 11.0 DSN Signaling Link Management. There are three signaling link management methods specified in ANSI T1.111.4. The automatic allocation of signaling data links and signaling terminals shall be the method implemented in the DSN.

e. 12.0 DSN Signaling Route Management.

(1) 12.1 General. The Signaling Route Management procedures are required to control signaling routes in the DSN nodes implemented with the SP/STP function. However, both DSN SP and SP/STP nodes shall be capable of responding appropriately to the receipt of Signaling Route Management messages. For example, a DSN SP node may be required to alter its routing information in response to a Transfer Prohibited, Restricted, or Allowed message.

The DSN use of Transfer Cluster Prohibited, Transfer Cluster Allowed, or Transfer Cluster Restricted procedures may be allowed by the DSN No.7 CCS specifications. Due to the limited initial use of quasi-associated signaling and clustering, these procedures are viewed as a future enhancement that shall not be precluded by the current implementations.

(2) 12.7 Transfer Controlled Procedure. Transfer Controlled is initiated at a DSN SP/STP node to notify one or more originating signaling points that they should no longer send messages to a destination with a give priority or lower. The Transfer Controlled message is sent in response to receipt of a signaling message, the priority of which is less than the current link congestion status. Suggested timer values shall initially be implemented. The DSN Network Administrator shall have control over timer values to accommodate specific DSN application requirements. A means to control timer value settings shall be provided.

f. 13.0 Common Characteristics of Message Unit (MSU) Formats.

(1) 13.2 Service Information Octet. The Service Information Octet of the MSU contains the service indicator and the subservice field. The subservice field is used to distinguish between internationally coded messages and messages coded according to the DSN standard and also contains an indication of the message priority levels.

(a) 13.2.1 Service Indicator. Not all coded users of the MTP are accommodated by DSN No.7. A listing of the service indicator codings and their current DSN implementation status is shown in the following:

D C B A		DSN
0 0 0 0	Signaling network management messages	YES
0 0 0 1	Signaling network testing and maintenance regular messages	YES
0 0 1 0	Signaling network testing and maintenance special messages	YES
0 0 1 1	SCCP	YES
0 1 0 0	Telephone User Part	NO
0 1 0 1	ISDN User Part	YES
0 1 1 0	Data User Part (call and circuit related messages)	NO
0 1 1 1	Data User Part (facility registration and cancellation messages)	NO
1 0 0 0	Spare	
1 0 0 1	Spare	
1 0 1 0	Spare	
1 0 1 1	Spare	
1 1 0 0	Spare	
1 1 0 1	Reserved for DSN only use	
1 1 1 0	Reserved for DSN only use	
1 1 1 1	Spare	

(b) 13.2.2 Subservice Field. The DSN shall use the network code (10) as specified in ANSI T1.111.4. DSN messages originating and terminating within the DSN or another network conforming to the ANSI standard shall also be coded with the National Network code (10).

DSN interconnections with international networks, via gateways or other methods, are a subject of separate specifications and agreements with the networks and countries concerned. Whether the international or other network indicator is used will be specified as a part of that agreement.

Priority 3 is the highest message priority code and is reserved for network management and other messages critical to the performance of the MTP. Assignment of priority levels to other messages and user parts shall be in accordance with the DSN specific guidelines. The IAM messages that carry the FLASH and FLASH OVERRIDE precedence levels are assigned the priority 2. The IAM messages with the IMMEDIATE are assigned the priority 1. The PRIORITY and ROUTINE precedence levels are at the 0 priority. This priority shall not be changed if a DSN call must cross the network boundaries. However, it is subject to bilateral agreements negotiated with other network providers. The DSN Network Administrator shall have the ability to assign and change priority levels for messages of specific user parts within the DSN and to agree with interconnecting networks for messages that enter and leave the DSN.

g. <u>14.0 Formats and Codes of DSN Signaling Network Management Messages</u>. The following paragraphs specify DSN requirements for the formats and codes of DSN Signaling Network Management Messages.

(1) The Signal Link Code (SLC), used to identify one of 16 possible signaling links between each pair of adjacent (directly connected) signaling nodes, indicates the identity of a signaling link to which a network management message pertains.

(2) Each adjacent DSN SP pair shall coordinate the assignment of SLCs to ensure compatibility.

(3) The SLC may be used in the DSN to identify the preferred order of signaling data link selection from among the inter-exchange circuits. Normally, one associated signaling link between two DSN signaling points will be implemented and designated with an SLC at both ends of 0000. The order of selection of backup signaling data links to be obtained from the inter-exchange circuit group may be pre-coordinated and prioritized at both ends. SLC 0001 is assigned to the circuit normally selected first as a backup signaling link. The remaining SLCs are assigned to inter-exchange circuits in the order of their selection as signaling data links. This order of selection should not be interpreted as prioritizing the signaling links. Any circuit selected to serve as a signaling link remains in service for that purpose until it becomes unavailable (e.g., by failure or management withdrawal, etc.)

(4) This pre-assignment can be overridden when communication between both DSN signaling points over alternative links is possible. In this case, a Signaling Data Link Connection Order message may be utilized to indicate which inter-exchange circuit will be assigned as a signaling data link and which corresponding SLC will be used.

7.8.2.5 ANSI T1.111.5-DSN Signaling Network Structure (MTP). The DSN No.7 CCS Signaling Network Structure shall be as specified in ANSI T1.111.5. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 1.0.

a. 1.0 Scope, Purpose, and Application. The DSN No.7 CCS network shall serve as a totally separate call control and management network that is overlaid on the DSN circuit- switched network. DSN signaling points connected by signaling links shall interface with DSN switch processors to provide the necessary messages and procedures to control voice and data related connections.

The DSN signaling network consists of SPs and SP/STPs collocated with DSN multi-function switches and interconnected by a network of signaling links. The DSN Signaling Network concept is based upon a fully-associated architecture. It consists of origination and destination SPs connected by signaling links which are capable of sharing the load between them. It is supplemented by quasi-associated signaling routes in which the information between origination and destination points may be transferred via a number of STPs. This architecture differs from the examples of a centralized paired-STP architecture shown in ANSI T1.111.5. The DSN architecture is built upon associated signaling links supplemented by a large number of dispersed (decentralized) STPs.

The DSN architecture, while different from commercial architectures based on the quasi-associated principles, is not in violation of ANSI T1.111.5. The major DSN No.7 CCS components are signaling points, signaling transfer points, and signaling links that are in compliance with the ANSI standard. The remainder of this section specifies DSN applications of these components in the signaling network.

b. 2.0 Signaling Network Components. This section describes the signaling network structure and individual components: the SP, the SP collocated with an STP, and a network of signaling links arranged in an associated network architecture.

(1) 2.1 Signaling Links. A DSN Signaling Link is a basic component that connects signaling points in a signaling network. The signaling links encompass the "level 2" functions that are specified in ANSI T1.111.3.

A signaling link connecting two signaling points shall correspond to the inter-exchange circuits connecting adjacent DSN switches in the circuit-switched network.

The associated architecture of the DSN requires one directly- connected active signaling link set between any two DSN switching centers. This link is drawn from one of the inter-exchange circuits serving these two switching locations. The remaining inter-exchange circuits (up to 15) may be used as backup signaling links and for the purposes of load sharing. They are considered to be inactive signaling links under normal circumstances and could be made available for a different purpose (e.g., voice transmission).

The signaling links directly connecting two DSN switches in the network constitute a single signaling link set.

Parallel signaling link sets (combined link sets) shall not be precluded by implementations.

(2) 2.2 Signaling Points. The typical signaling component installed at DSN switches shall consist of a SP collocated with an STP (SP/STP), unless specifically stated otherwise. The SP/STP shall serve as signaling message origination, transfer point, and destination point.

The signaling component that has been specifically stated as not requiring the STP function shall consist of an SP only. These DSN SPs shall serve as origination and destination points for signaling messages, but not as transfer points.

Typical locations of DSN SPs without the STP capability will be switches that connect to either a single switch or a very limited number of adjacent DSN switches.

The switches limited to the SP capability do not provide alternate routing for another switch served by common channel signaling. Upgrade of a DSN SP to a DSN SP/STP should not be precluded by the SP implementation.

As a minimum, a single signaling link shall exist between every adjacent switch in the DSN backbone network. Up to 16 inter- exchange circuits to the adjacent switches are available in DSN No.7 CCS.

All of the DSN backbone switches are considered to be network SPs. Each SP and SP/STP shall be assigned a unique signaling point code for addressing signaling messages.

SPs and SP/STPs shall interface directly to the DSN switch processor. The DSN SP only nodes shall provide at least two of the level 3 functions: 1) the message distribution function, which delivers a received message to the appropriate user part or to the local MTP levels of the home SP; and 2) the routing function, which makes a choice of an outgoing signaling link that routes a message to a destination SP.

The DSN network concept is based on the decentralization and dispersion of STP capability throughout the signaling network. This concept requires STPs to be collocated with most DSN switch signaling points.

As described above, an SP/STP is used for quasi-associated backup of an unavailable associated route. Under the DSN concept, a quasi-associated link cannot be used for backup of another quasi- associated unavailable route.

The STP capability in the DSN requires at least two of the level 3 functions to be present: message discrimination function and message routing function. The discrimination function allows the DSN to determine that a message is destined to another STP. It initiates the routing function which selects an outgoing signaling link.

Figure 3, Typical DSN SP/STP Location shows a typical network configuration with primary and alternate signaling routes for setting up calls from A to B. The nodes represent both circuit switches and signaling nodes. A and B are adjacent switches connected by associated signal links that form the normal or primary route. Most calls under normal conditions will flow over this route. When all trunks/links on the normal route are busy, calls from A to B are set up over the alternate nodes.

The failure of any signal link shall be backed up with the DSN quasi-associated capability. For example, quasi-associated signaling route (shown in Figure 3, Typical DSN SP/STP Location) provides a backup capability for the failed associated

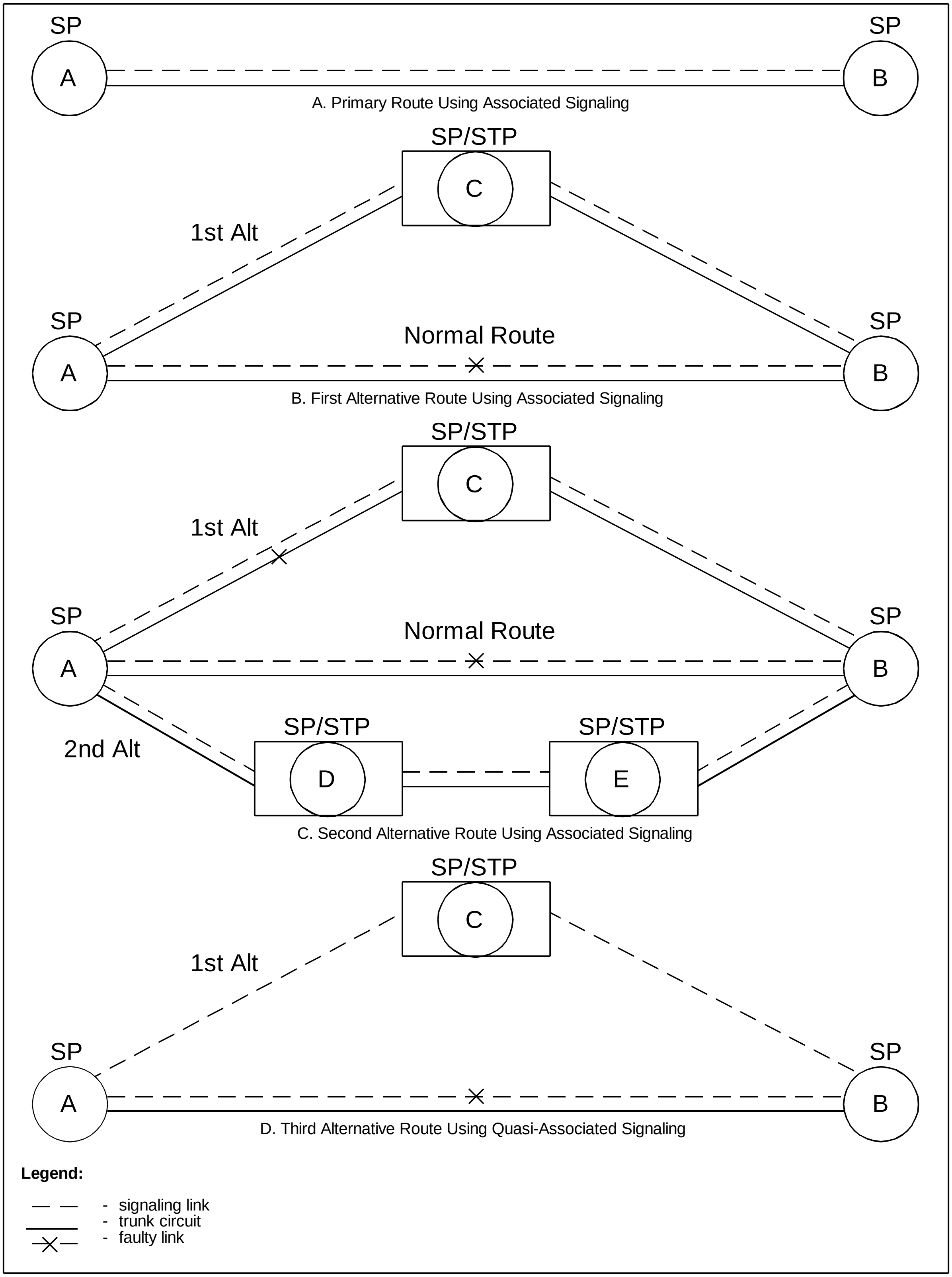

FIGURE 3. Typical DSN SP/STP location.

signaling link between A and B. Calls will be set up over the A to B trunk circuits. For this to work, the node at C must have the STP capability, where a call from A to B may be set up via the C signaling node without being routed through switch C.

Any DSN signaling point that is a part of a backup signaling route for two adjacent DSN signaling points must be an SP/STP. In order to allow future upgrading of the DSN network, all DSN SPs shall have the potential to be upgraded to a DSN SP/STP.

c. <u>3.0 Structural Division of DSN Signaling Network (National and International Requirements)</u>. The worldwide signaling network outside the DSN network consists of two functionally independent levels: the international level and the national level. The overall DSN structure reflected by the signaling network management and the numbering plans of signaling points provides the network with the capability to function on both the national and the international levels. A DSN SP/STP shall be assigned to one of two categories:

(1) A node that functions as an ANSI specified (T1.111.5) national signaling point (signaling transfer point). This type belongs to the DSN signaling network only and is identified by a signaling point code [Originating Point Code (OPC) or DPC] according to the DSN numbering plan of signaling points

(2) A node that functions both as an international signaling point (signaling transfer point), and a DSN signaling point (signaling transfer point), and therefore belongs to both the DSN and the international signaling network, and is identified by a specific signaling point code (OPC or DPC) in each of the signaling networks accordingly.

d. <u>4.0 Considerations Common to Both International and National Signaling Networks</u>.

(1) <u>4.4 Number of Signaling Links Used in Load Sharing</u>. Load sharing among parallel link sets is not precluded by this specification if the parallel sets (combined link sets) are implemented in DSN No.7 CCS. If implemented, the number of signaling links used in load sharing is implementation dependent, and shall be part of the DSN No.7 implementation guidance.

(2) <u>4.5 Satellite Link Use</u>. The DSN circuit switched backbone shall encompass satellite routes. Calls traversing different calling areas could encounter several satellite circuits. The DSN Satellite Link Use is for further Study.

e. 6.A Signaling Network for Internetwork Traffic.

(1) 6A.1 General. The traffic between DSN SP/STPs requires extended protocol capabilities (to be defined) to provide for appropriate monitoring and measurements. Unlike the national networks specified in the corresponding section of the ANSI Standard, the DSN network employs associated signaling with quasi-associated capabilities. Based on this architecture, the internetwork traffic requirements for the DSN network are different. The internetwork traffic requirements are specified in the following paragraphs.

(2) 6A.2 Integrated Numbering of National Signaling Networks. Signaling Gateways are not required within the DSN because DSN No.7 CCS operates under a uniform protocol throughout all DSN areas. Gateways may become a requirement to interconnect the DSN with other international CCITT No.7 networks. This can only be determined by agreement with each interconnecting network.

(3) 6A.5 Routing in the Absence of Failures. The SLC bit rotation procedure used for load sharing in the U.S. national networks shall be implemented in the DSN network only for load sharing within the link set.

f. 7.0 DSN Signaling Network Framework. The DSN network shall employ "F" links to connect every SP and SP/STP together. These "F" links shall provide the associated architecture of the DSN. That is, every pair of directly connected (adjacent) DSN switches shall be connected by an "F" type of associated signaling link (Figure 4, F-links).

These signaling links may also carry signaling traffic that is characteristic of other types of signaling links. For example, when quasi-associated backup signaling is employed, the "F" signaling link will logically appear to be an "A" link providing access from a SP to a STP. Similarly, an "F" between two DSN SP/STPs could in some cases carry quasi-associated signaling between the two STPs and appear as a logical "B" link. Similar examples can be stated where the DSN "F" link carries traffic that will provide the logical appearance of "D" and "E" type links. Because the DSN SP/STPs do not operate in mated pairs, no "C" link implementations will occur in the DSN.

7.8.2.6 ANSI T1.111.6-DSN Message Transfer Part Signaling Performance (MTP). The DSN No.7 CCS requirements and guidelines for the MTP signaling performance shall be as specified in ANSI T1.111.6.

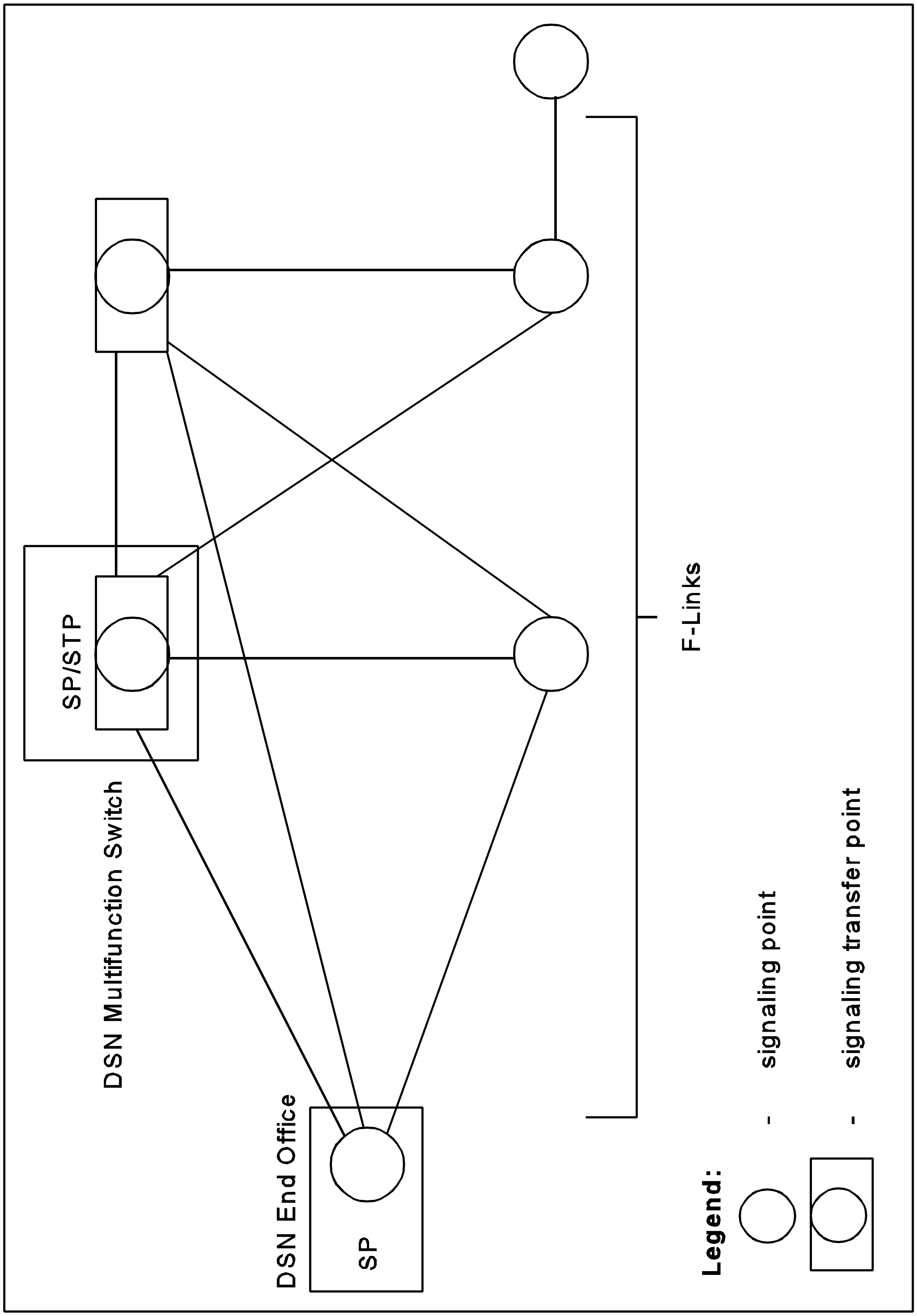

FIGURE 4. F-links.

APPENDIX A

7.8.2.7 ANSI T1.111.7-DSN Testing and Maintenance (MTP). The DSN No.7 CCS Testing and Maintenance requirements shall be as specified in ANSI T1.111.7.

7.8.2.8 ANSI T1.111.8-Numbering of Signaling Point Codes (MTP). The DSN No.7 Numbering of Signaling Point Codes shall be as specified in ANSI T1.111.8. The DSN meets the ANSI requirements for a large network and has been granted a network code value of 241. ANSI T1.111.8, Table B1, shows the current list of assigned large network codes. Signaling point codes in the DSN are assigned by the Network Administrator in accordance with ANSI guidelines.

7.8.3 Signaling Connection Control Part (SCCP). The DSN No.7 CCS SCCP shall be as specified in ANSI T1.112-1988, Chapters 1-4. Specific requirements for DSN application are given in the following subsections.

7.8.3.1 ANSI T1.112.1-Functional Description of the Signaling Connection Control Part. The DSN No.7 CCS SCCP functional description shall be as specified in ANSI T1.112.1. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Services Provided by the SCCP. The SCCP provides additional functions to the MTP to provide both connectionless as well as connection oriented network services to transfer circuit related and noncircuit-related signaling information and other types of information between exchanges. The connectionless services requires a function which maps the called address to Signaling Point Codes of the MTP-Service. This function shall be provided within each DSN No.7 CCS node. (See ANSI T1.112.1, Section 2.2).

7.8.3.2 ANSI T1.112.2-Definition and Function of SCCP Messages. The definition and function of DSN No.7 CCS SCCP messages shall be as specified in ANSI T1.112.2.

7.8.3.3 ANSI T1.112.3-SCCP Format and Codes. The DSN No.7 CCS SCCP formats and codes shall be as specified in ANSI T1.112.3.

7.8.3.4 ANSI T1.112.4-Signaling Connection Control Part Procedure. The DSN No.7 CCS SCCP procedures shall be as specified in ANSI T1.112.4. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Addressing and Routing.

(1) SCCP Routing Principles. The SCCP Routing Control (SCRC) shall be required to translate a calling party address from PC + SSN to GT.

b. 5.0 SCCP Management Procedures. SCCP management procedures defines how replicated nodes or subsystems may relate. Within DSN, nodes/subsystems shall operate in the dominate role, which is consistent with the philosophy of main-associated and backup-quasi-associated signaling.

7.8.4 DSN No.7 CCS Integrated Services Digital Network User Part (ISDN-UP). The DSN No.7 CCS ISDN-UP shall be as specified in ANSI T1.113-1990, Chapters 1-5. Specific requirements for DSN application are given in the following subsections.

7.8.4.1 ANSI T1.113.1-Functional Descriptions of ISDN User Part (ISDN-UP). The DSN No.7 CCS ISDN-UP functional description shall be as specified in ANSI T1.113.1-1990. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 1.0.

a. 1.0 Scope, Purpose, and Application. The ISDN-UP specifies the signaling functions, codes, messages, and procedures needed to provide services for circuit-switched voice and data services in the DSN. The ISDN-UP serves analog, digital, mixed analog/digital, and ISDN Networks. The broad application base of the ISDN-UP provides accommodation for the evolution of the DSN from an analog to an all digital network.

b. 2.0 Services Supported By The ISDN User Part. In addition to the basic service and the non-ISDN supplementary services specified in the standard, the Multi-Level Precedence and Preemption service, as specified in T1.619, is mandatory.

c. 4.0 End-To-End Signaling. End-to-end signaling transports signaling information between the end points of a circuit-switched connection or between any two points in the signaling network. Both end-to-end signaling methods (i.e., pass along and SCCP) shall be supported in DSN No.7 CCS.

7.8.4.2 ANSI T1.113.2-General Function of Messages and Signals. The DSN No.7 CCS ISDN-UP general functional of messages and signals shall be as specified in ANSI T1.113.2-1990. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 1.0.

a. 1.0 Signaling Messages. The signaling messages available for DSN No.7 are specified in ANSI T1.113.2-1990. Table 2/T1.113.2 lists the ISDN-UP messages and their acronyms.

These messages could be divided into several categories with respect to their functional content pertinent to connection setup, operations, supervision, tests, and maintenance.

b. 2.0 Signaling Information. Signaling information is identified in subsections 2.1 through 2.77. The following has specific DSN comments:

(1) 2.41 End-to-End Method Indicator. In the DSN both the SCCP and the Pass Along methods shall be available.

7.8.4.3 ANSI T1.113.3-Formats and Codes. The DSN No.7 CCS ISDN-UP Formats and Codes shall be as specified in ANSI T1.113.3-1990. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 3.0.

a. 3.0 ISDN-UP Parameters. The format of the various ISDN-UP parameters are given in subsections 3.1 through 3.33 of the ANSI standard, all of which are applicable to the DSN. The following has specific DSN comments:

(1) Precedence Parameter. In the DSN No.7 System, a Precedence parameter of one octet in length shall be used in the Initial Address Message to indicate the precedence level, service domain, and LFB status of each call. Table I provides the DSN No.7 CCS system coding for each subfield.

Table I. Precedence Parameter

SUBFIELDS	DSN NO. 7 CODING
Precedence Level	Bits 3-1
Flash override (0)	000
Flash (1)	001
Immediate (2)	010
Priority (3)	011
Routine (4)	100
	*
MLPP service domains	Bits 6-4
DSN	000
	*
LFB status	Bits 7-8
LFB allowed	00
LFB not allowed	10
Path reserved	01

* all other values are spare

7.8.4.4 ANSI T1.113.4-Signaling Procedures. The DSN No.7 CCS ISDN-UP Signaling Procedures shall be as specified in ANSI T1.113.4-1990. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Basic Call Control and Signaling Procedures.

(1) 2.1.1.1 Actions Required at Originating Exchange. Routing information in the DSN shall be supplied by the originating exchange. However, the design shall not preclude requests to a remote database for routing information.

b. Multilevel Precedence and Preemption. Multi-level Precedence and Preemption (MLPP) Service provides a set of optional call handling procedures for use in an ISDN network. These procedures are applicable to any network that provides the MLPP capability. Utilization of MLPP procedures provides essentially nonblocking service to very high priority users. This ensures the ability to communicate during network congestion periods. The ISDN-UP signaling procedures for the MLPP Service are covered in T1.619.

7.8.4.5 ANSI T1.113.5-Performance Objectives in the ISDN Application. The DSN No.7 CCS performance requirements for an ISDN application shall be as specified in ANSI T1.113.5.

7.8.5 Transaction Capability Application Part (TCAP). The DSN No.7 CCS TCAP shall be as specified in ANSI T1.114-1990, Chapters 1-5. Specific requirements for DSN application are given in the following subsections.

7.8.5.1 ANSI T1.114.1-Functional Description and Transaction Capabilities. The DSN No.7 CCS Transaction Capabilities shall be as specified in ANSI T1.114.1-1990.

7.8.5.2 ANSI T1.114.2-Definition and Functions of Transaction Capabilities Messages. The elements and functions of DSN No.7 CCS TCAP messages shall be as specified in ANSI T1.114.2-1990.

7.8.5.3 ANSI T1.114.3-TC Format and Codes. The DSN No.7 CCS formats and encodings for TCAP messages shall be as specified in ANSI T1.114.3-1990.

7.8.5.4 ANSI T1.114.4-Transaction Capability Procedure. The DSN No.7 CCS TCAP procedures shall be as specified in ANSI T1.114.4-1990.

7.8.5.5 ANSI T1.114.5-Definitions of Operations, Parameters and Error Codes. The DSN No.7 CCS functions and encoding for the Operation, Parameter and Error Code elements used by the TCAP protocol shall be as specified in ANSI T1.114.5-1990. DSN specific requirements not covered by the standards are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Operations.

(1) 2.1.1 Parameter Family Identifier - 0000001. This indicates that the following operations on Parameters is to be performed. In DSN No.7 CCS the Parameter - Provide Value Specifier - 00000001, is used in the MLPP service for the Look-ahead for busy option that will determine if circuits are available before action is taken to preempt the call. The operation of this parameter is used to indicate that the values in the Parameters identified in the Parameter Set are to be provided. In the case of MLPP service, this operation specifies the following mandatory parameters:

(a) The Look-ahead For Busy Response*

(b) Bearer Capability Supported*

(c) The Service Key which encompasses the following:

-- The Called Party number
-- The Calling Party number
-- The Circuit Identification Code*
-- The Bearer Capability Requested
-- The Precedence*
-- The Call Reference.*

When the operation is performed successfully, a Return Result with the following parameters are returned:

-- The Look-ahead for Busy Response*
-- The Bearer Capability Supported*

If the operation cannot be performed, the Return Error cause may be one of the following:

-- Unexpected Data Value-if the argument of the operation is not as expected
-- Data Unavailable-if the data identified was not available
-- Task Refused-if the entity is unable to do the task at this time.

* These parameters are either not in T1.114.5 or must be modified. See paragraph 7.8.5.5 (b) for details.

b. 4.0 Parameters. Several Parameters needed to support the MLPP Service are not yet fully defined in T1.114.5-1990. The DSN-specific Parameters are specified in the following paragraphs, citing the applicable sections in the standard if they exist:

(1) 4.19 Bearer Capability Requested - 10010010. The Bearer Capability Requested parameter is used to indicate the Bearer Capability requested by the calling party. It is coded contextual (in the context of the Parameter Set) and has a primitive form. The format and contents of the Bearer Capability Requested parameter is provided in T1.114.5

(2) 4.20 Bearer Capability Supported - 10010011. This parameter indicates whether or not a requested bearer capability is supported and is used to indicate the reason a bearer capability requested was not available. The format of the Bearer Capability Supported parameter is illustrated in Figure 3/T1.114.5. The contents of this Parameter are defined and coded as follows:

(a) 00000001 - Bearer Capability is not supported
(b) 00000010 - Bearer Capability is supported
(c) 00000011 - Bearer Capability is not authorized
(d) 00000100 - Bearer Capability is not presently available
(e) 00000101 - Bearer Capability is not implemented

(3) Look-ahead for Busy Response - XXXXXXXX. The Look- ahead For Busy Response Parameter is used to indicate whether the preemptable resources were found. The parameter is coded contextual. It is 1 octet long and is of type OCTET STRING. Its format is illustrated in Figure 5. The contents of are defined and coded as follows:

(a) Location. Bits DCBA indicate the location which initiated the response and are defined and coded as follows:

0000 - User
0001 - Private network serving the local user
0010 - Public network serving the local user
0011 - Transit network
0100 - Public network serving the remote user
0101 - Private network serving the remote user
0110 - Local interface controlled by this signaling link
0111 - International network
1010 - Beyond an interworking point
All other values are spare.

	H	G	F	E	D	C	B	A
Look-ahead For Busy Response	X	X	Spare		X	X	X	X

The Look-ahead for busy response length is one octet.

The location field is as follows:

Location	D	C	B	A
User	0	0	0	0
Private Network Serving the Local User	0	0	0	1
Public Network Serving the Local User	0	0	1	0
Transit Network	0	0	1	1
Public Network Serving the Remote User	0	1	0	0
Private Network Serving the Remote User	0	1	0	1
Local Interface Controlled by this Signaling Link	0	1	1	0
International Network	0	1	1	1
Beyond an Interworking Point	1	0	1	0
All other values are reserved				

The location field is as follows:

Acknowledgement Type	H	G
Path Reservation Denied	0	0
Negative Acknowledgement	0	1
Positive Acknowledegement	1	0
Spare	1	1

FIGURE 5. Look-ahead for busy response.

(b) Acknowledgement Type. Bits HG indicate the acknowledgement type. This indicates whether the request for search and reservation of circuits was accepted. Bits HG are defined and coded as follows:

00 - Path reservation is denied
01 - Negative acknowledgement
10 - Positive acknowledgement
11 - Spare

(4) Circuit Identification Code - XXXXXXXX. The Circuit Identification Code Parameter is used to identify the physical path between two exchanges. The parameter is coded contextual, is 2 octets in length and is of type OCTET STRING. The format and coding is as described in T1.113.3 Section 1.2.

(5) Precedence - XXXXXXXX. The Precedence Parameter is used to identify the MLPP call in terms of priority treatment and MLPP Service Domain. It is of variable length and is of the type OCTET STRING. The format is illustrated in Figure 6 and the contents are coded as follows:

First octet - Bits DCBA indicate the Precedence Level and are coded as follows:

(a) 0 0 0 0 - FLASH OVERRIDE(0)
(b) 0 0 0 1 - FLASH(1)
(c) 0 0 1 0 - IMMEDIATE(2)
(d) 0 0 1 1 - PRIORITY(3)
(e) 0 1 0 0 - ROUTINE(4)

Bits GFE are spare
Bit H is extension indicator

Second octet - Bits GFEDCBA indicate an identity of the MLPP service domain and are coded as follows:

(a) 0 0 0 0 0 0 0 - Defense Switched Network

All other values are spare.
Bit H is extension bit

(6) Call Reference - XXXXXXXX. The Call Reference Parameter is used to identify a particular MLPP call within an exchange independent of the physical circuits. The parameter is 6 octets in length and is of type OCTET STRING. The format contents are as specified in Section 3.5 and Figure 7 in T1.113.3.

	H	G	F	E	D	C	B	A
Precedence	ext	Spare			X	X	X	X
Domain	ext	X	X	X	X	X	X	X

The precedence parameter length is 2 octets.

The precedence octet is coded as follows:

Location	D	C	B	A
Flash Override (0)	0	0	0	0
Flash (1)	0	0	0	1
Immediate (2)	0	0	1	0
Priority (3)	0	0	1	1
Routine (4)	0	1	0	0

The location field is as follows:

MLPP Service Domain	G	F	E	D	C	B	A
Defense Switched Network	0	0	0	0	0	0	0
Spare	0	0	0	0	0	0	1
				To			
	1	1	1	1	1	1	1

FIGURE 6. Precedence format.

7.8.6 DSN No.7 CCS Management. The DSN No.7 Management specifications shall be as specified in Sections 7.8.6.1 and 7.8.6.2.

7.8.6.1 ANSI T1.115-Monitoring and Measurements of SS7. DSN No.7 CCS Monitoring and Measurements shall be as specified in ANSI T1.115.

7.8.6.2 ANSI T1.116-Operations, Maintenance and Administration Part (OMAP). The DSN No.7 CCS Operations, Maintenance and Administration Part shall be as specified in ANSI T1.116. DSN specific requirements are specified in the following paragraphs, citing the applicable sections of the standard, e.g., 2.0.

a. 2.0 Operations and Maintenance Procedures for the Signaling Network.

(1) 2.3.2 Screening. Both options of screening shall be available in the DSN.

(2) 2.5.4.2.3 Duplex Translation. This option is not supported in the DSN.

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER: **MIL-STD-187-700B**	2. DOCUMENT DATE (YYMMDD) **96/04/02**

3. DOCUMENT TITLE: Interoperability and Performance Standards for the Defense Information System

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

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APPENDIX A

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